Use of Rocuronium and Sugammadex for a Patient With Controlled Polymyositis: A Case Report

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Muscle relaxants and their reverse drugs should be carefully administered to patients with acute polymyositis and/or dermatomyositis. However, the use of these drugs in controlled polymyositis and/or dermatomyositis is controversial. This case report describes the use of rocuronium and sugammadex in a 27-year-old female patient with controlled polymyositis who was scheduled for minor oral surgery under general anesthesia. General anesthesia was induced rapidly, and 0.66 mg/kg of rocuronium was administered prior to nasotracheal intubation. No additional muscle relaxants were administered during the surgery. At the end of surgery, approximately 2 hours after the rocuronium was administered, her train-of-four (TOF) ratio was still 49%. A dose of 3.3 mg/kg of sugammadex was administered, and it took 12 minutes for the TOF ratio to exceed 90%. The prolonged duration of muscle relaxation in patients with polymyositis may be due to a decrease in skeletal muscle and capillary volume. The slow onset of sugammadex may be caused by slow diffusion of rocuronium from the neuromuscular junction. Patients with polymyositis require close perioperative neuromuscular function monitoring, regardless of their disease control status.

Key Words: General anesthesia; Polymyositis; Rocuronium; Sugammadex.

Polymyositis, categorized as an inflammatory myopathy, is an autoimmune tissue disorder of skeletal muscle that involves infiltration of mononuclear cells around non-neurotic myofibers in skeletal muscle and the degeneration, necrosis, and regeneration of myofibers.[1,2] Polymyositis causes slow muscle weakness that mainly affects the trunk, proximal limb, neck, and pharyngeal muscles.[1,2] In addition to the symptoms of polymyositis, dermatomyositis is diagnosed when it is accompanied by characteristic skin rash, such as a heliotrope rash or Gottron sign or papules.[1,2] The pathogenesis of these diseases is understood to be the same, and they have poor prognoses when patients have rapidly progressive interstitial pneumonia or malignancy.[1–3]

Care should be taken with using muscle relaxants and reversal agents during general anesthesia for patients with polymyositis because of the potential for reduced or atrophied skeletal muscle.[4] Therefore, surgery should be performed under local anesthesia whenever possible.[5,6] The use of all types of muscle relaxants for patients with controlled polymyositis remains controversial, as it has long been discussed in the existing literature on general anesthesia for patients with acute polymyositis and dermatomyositis.[7,8] In this case report, we describe the management of a dental patient with controlled polymyositis undergoing intubated general anesthesia for dental extractions. Written informed consent was obtained from this patient and reported in accordance with the case reports guidelines.

CASE PRESENTATION

The patient was a 27-year-old woman (height, 167 cm; body weight, 60 kg; body mass index, 21.5 kg/m^2) with polymyositis who was scheduled to undergo general anesthesia for extraction of bilateral maxillary and mandibular third molars. Four years previously she experienced lower limb dyskinesia and general malaise while performing classical ballet and was diagnosed with polymyositis after magnetic resonance imaging and muscle biopsy. She was treated initially with prednisolone and cyclosporine, and once her acute symptoms were in remission, her polymyositis was controlled with prednisolone (2 mg/d). The patient reported no ongoing muscle weakness and had no daily limitations, with an estimated metabolic equivalent

Received April 30, 2023; accepted for publication October 9, 2023.

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Anesth Prog 71:81–84 2024 | DOI 10.2344/021627

task value of more than 6.0. Preoperative screening tests revealed a normal creatinine kinase level (71 U/L; normal, 30-145 U/L in females), C-related protein (0.08 mg/dL; normal, <0.3 mg/dL), and erythrocyte sedimentation rate (6 mm/h; normal: 0-20 mm/h in females), indicating that her polymyositis was under control. The patient had normal renal and hepatic function, and no other noteworthy findings were noted in review of her medical history. Her prednisolone was continued as usual during the perioperative period.

Upon the patient's arrival at the operating room, standard anesthetic monitors were applied, intravenous (IV) access was obtained, and she was appropriately preoxygenated. General anesthesia was rapidly induced with IV propofol (130 mg) and fentanyl (100 μg) followed by rocuronium (40 mg; 0.66 mg/kg) after confirming ease of mask ventilation. Nasotracheal intubation was successfully performed without difficulty, and general anesthesia was maintained with O_2 (1 L/min), air (3 L/min), and sevoflurane (1.5%–2%) along with a remifentanil infusion (0.1–0.2 μg/kg/min).

After induction and securing the airway, the neuromuscular blockade (NMB) depth was monitored using a peripheral nerve stimulator (TOF-Watch, Merck & Co, Inc,) placed along the ulnar nerve to stimulate the adductor pollicis brevis muscle. The train-of-four (TOF) mode, which applies 4 consecutive stimuli (ie, 2 Hz) every 0.5 seconds, is evaluated based on the ratio of the heights of the fourth stimulation (T4) to the first stimulation (T1). The TOF ratio (T4/T1) is almost 100% when no neuromuscular blocking agents are present but decreases as NMB deepens. The chronological results of the patient's NMB data are presented in the (Table). No additional rocuronium was administered during surgery. Sevoflurane was started at 2% after tracheal intubation, changed to 1.5% at 15 minutes before the end of surgery, and discontinued at the end of surgery. Although 2 hours had elapsed since rocuronium was administered during induction, the TOF ratio was 49%.

At the end of surgery (ie, 120 minutes after administration of rocuronium), IV sugammadex (200 mg) was administered to antagonize the rocuronium-induced NMB; however, it took 12 minutes for the TOF ratio to exceed 90%. The patient was extubated without difficulty after emerging from general anesthesia and confirming adequate spontaneous ventilation. The duration of the operation was 85 minutes, and the total duration of anesthesia was 140 minutes. No postoperative complications were observed. The patient was discharged the day after surgery.

Table. Changes in Muscle Relaxation State During General Anesthesia[a]

Time elapsed since administration, min	*TOF count, No./total, or TOF ratio, %*[b]
Rocuronium	
25	0/4
85	2/4
105	18%
115	38%
120	49%
Sugammadex	
1	64%
6	78%
11	82%
12	97%

[a] TOF indicates train of four.
[b] The number of twitches due to neuromuscular stimulation (TOF count) was determined when the height of the stimulation was undetectable or when the TOF ratio was <20%. TOF ratio = T4/T1; T1, height of first stimulation; T4, height of fourth stimulation.

DISCUSSION

In the present case, we experienced a prolonged duration of rocuronium-induced NMB and a delayed return of neuromuscular function following the administration of sugammadex during intubated general anesthesia for a patient with controlled polymyositis.

C-related protein and erythrocyte sedimentation rate are also used to diagnose polymyositis, but creatinine kinase level is used as the most sensitive responding muscle enzyme.[2] Creatine kinase concentration usually parallels disease activity and is always increased during active polymyositis phases, up to 50 times normal levels during acute active phases.[2] Creatine kinase is an enzyme present in skeletal and cardiac muscle that is released into the blood after cell damage. Reference values vary depending on sex because of differences in muscle mass (normal, 62–287 U/L for males and 45–163 U/L for females). In this case, preoperative screening showed that the patient's creatinine kinase level was within normal limits at 71 U/L. Her other lab values, continued prednisolone therapy, and lack of clinical signs or symptoms indicated that her polymyositis was under control, suggesting possible normal sensitivity to rocuronium and sugammadex.

In the histologic findings of polymyositis, it has been reported that intramuscular blood vessels show endothelial hyperplasia with tubulovesicular profiles, fibrin thrombi, and capillary obliteration, resulting in a reduction in capillary density.[2] Muscle fibers undergo phagocytosis and necrosis, resulting in perifascicular atrophy.[2] Moreover, in polymyositis, multifocal lymphocytic infiltrates surround and invade healthy muscle fibers.[2] These reports suggest that patients with polymyositis have not only reduced skeletal muscle volume but also decreased capillary volume, possibly indicating that delayed onset and prolonged duration of nondepolarizing muscle relaxants acting on the neuromuscular junction may occur. Rocuronium, which acts on the neuromuscular junction, has a shorter duration of

action than some nondepolarizing muscle relaxants (eg, pancuronium). In young, healthy adults, it has been reported that the time required for a TOF ratio greater than 90% to return following a 0.6 mg/kg dose of rocuronium was 50 to 70 minutes during propofol-maintained general anesthesia.[9] When 0.6 mg/kg of rocuronium was used, it has been reported that approximately 110 minutes were required for NMB recovery to a TOF ratio more than 90% when using sevoflurane for general anesthesia maintenance, as it enhances the NMB potency of rocuronium.[10,11] This NMB potentiation occurs with other volatile agents (ie, isoflurane and desflurane).[10] In this case rocuronium was administered at 0.66 mg/kg, and by 120 minutes the TOF ratio had recovered only to 49%, suggesting a prolonged duration of rocuronium-induced NMB.

Sugammadex is designed to reverse steroidal neuromuscular relaxants such as rocuronium.[12] It has been reported that the TOF ratio recovered to 90% within approximately 2 minutes when a 2.0 mg/kg dose of sugammadex was administered after the presence of 2 twitches was identified using peripheral nerve stimulation.[13] The dose of sugammadex administered in this case was 3.3 mg/kg; however, the TOF ratio still took 12 minutes to recover from 64% to 97%, indicating delayed onset of sugammadex in this patient with polymyositis. In patient with dermatomyositis, the slow onset of action of rocuronium and sugammadex is reportedly due to the slow diffusion of rocuronium from the neuromuscular junction to the plasma.[14]

A limitation of this case report is that the TOF ratio was not measured right after induction of general anesthesia prior to the administration of rocuronium. Furthermore, we did not monitor the onset of rocuronium-induced NMB either. Assessing the patient's neuromuscular status at these times would have helped to determine if the patient was overly sensitive to rocuronium. Because the onset of action of rocuronium has been reported to be delayed in patients with dermatomyositis, a similar reaction may have occurred in the present case.[14]

Monitoring the onset and depth of NMB during general anesthesia in patients with polymyositis is important. The choice of agents for maintenance of general anesthesia in this case may have been inappropriate given the possibility of sevoflurane's potentiating muscle relaxant effects.

Although neuromuscular responses to a depolarizing muscle relaxant (ie, succinylcholine) have been reported to be normal in patients with polymyositis,[15] hyperkalemia is a risk and could be induced if the muscle tissues are inflamed during an active phase.[7] Other nonsteroidal nondepolarizing muscle relaxants, namely benzylisoquinolines (ie, atracurium/cisatracurium), also act by competitive antagonism of acetylcholine receptors, similarly to rocuronium. Considering that delayed onset and/or prolonged action of muscle relaxants possibly results from impaired blood flow at the neuromuscular junction, close monitoring of muscle relaxation may be necessary when using any nondepolarizing muscle relaxants. Based on this case, it is suggested that sugammadex can be used safely with proper monitoring to patients with controlled polymyositis. In addition, use of nonsugammadex NMB reversal (ie, neostigmine/glycopyrrolate) has been reported to be safe.[16,17] Further studies are needed to identify ideal neuromuscular blocking agents and reversal drugs in patients with controlled polymyositis.

CONCLUSION

Patients with controlled polymyositis may be sensitive to nondepolarizing muscle relaxants (eg, rocuronium) and have prolonged action/paralysis and delayed recovery, likely due to impaired capillary blood flow. These patients should be closely monitored using a peripheral nerve stimulator throughout the perioperative period. Furthermore, muscle relaxant doses should be reduced/titrated carefully to effect to minimize risk of overdose/prolonged NMB, and full NMB reversal should be utilized to help ensure adequate neuromuscular function upon awakening.

ACKNOWLEDGMENTS

The authors declare that they have no conflicts of interest. The authors are grateful to Prof Kanta Kido, Department of Dental Anesthesiology, Hokkaido University, and Drs Ayako Mizutani and Keita Kagawa, Department of Dental Anesthesiology, Kanagawa Dental University, for their helpful discussions on this case report. We also thank Editage (www.editage.jp) for English language editing.

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