

Postoperative recurrence of paralysis following extravascular injection of rocuronium bromide in an elderly patient with normal renal and hepatic function

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Dear Editor,

Extravasation is an unintended injection or leakage of liquid or drug extravascularly or subcutaneously. After placing an intravenous (IV) catheter, anaesthesiologists should check its insertion site. Often, it can be difficult to determine whether the catheter is positioned in a vein [1]. While there have been a few reports on extravasation of rocuronium, almost all reports have shown successful perioperative management of an intubating dose of rocuronium with neuromuscular monitoring [2–5]. Such reports have recommended objective monitoring of neuromuscular blockade as soon as possible if unintended subcutaneous leakage of rocuronium is suspected. However, some studies have found that poor acceptance of neuromuscular devices in clinical practice is due to their steep learning curve and limited accuracy [6]. For example, neuromuscular monitoring for muscle relaxants, which has not yet been calibrated, has a negative predictive value of 40%, so it may not be possible to identify the presence of neuromuscular blocking agents (NMBAs) and prevent dyspnoea [5].

In our present case, we found postoperative reparable paralysis following extravascular injection of rocuronium because of a lack of neuromuscular monitoring in an elderly patient with normal renal and liver function. In our hospital, neuromuscular monitoring was not available in all operating rooms until our institution increased its availability in response to the pres-

ent case. Therefore, based on our present case, two things need to be emphasized: (1) try to avoid giving rocuronium that infiltrates through an IV line by first checking if the propofol is working, and (2) use nerve monitoring in all such cases, especially following the extravasation of rocuronium.

An 84-year-old female patient (height 150 cm and weight 40 kg) was admitted for emergency surgery due to small bowel obstruction in the setting of a strangulated inguinal hernia. She has approved the publication of her case. Based on her physical examination, she had dementia and hypertension. She was taking amlodipine besylate for the hypertension. Her past medical history was unremarkable except for surgery for acute appendicitis. Laboratory findings noted hypoalbuminaemia (2.3 g dL^{-1}). Her renal function and liver function were normal. An IV cannula was already in the right antecubital fossa from her admission to the previous hospital. Oedema was observed in her extremities. An IV drip was put in place before induction.

After the placement of routine monitors with the exception of a neuromuscular monitoring device, the patient had no evidence of sedation despite injection of 40 mg of propofol and 50 mg of rocuronium for rapid sequence induction, and she complained of pain during the injection. A presumptive diagnosis of propofol and rocuronium extravasation was made. A second 22-gauge IV catheter was promptly inserted in the most prominent vein on the dorsum of the

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left hand, and 40 mg of propofol and 40 mg of rocuronium were administered within 5 min for tracheal intubation. Then, the IV catheter in the right arm was removed. Anaesthesia was maintained with desflurane at 3% plus room air (1 L min⁻¹) and oxygen (1 L min⁻¹) with remifentanyl (0.2 µg kg⁻¹ min⁻¹). Ringer's acetate solution was infused at a rate of 18 mL kg⁻¹ hour⁻¹. At the start of surgery, her body temperature as measured at the nare was 35.3°C. During the operation, 10 mg of ephedrine and 0.05 mg of phenylephrine were administered intravenously for hypotension. The remainder of the procedure and sedation were uneventful.

Forty-one minutes after the last rocuronium administration, the surgery was completed. Then, room air, desflurane, and remifentanyl were discontinued at the same time. The operation took approximately 30 min. The total doses of propofol and rocuronium were 80 mg and 90 mg, respectively, including the extravasated quantities. The patient started to breathe spontaneously, with a tidal volume of 250 mL, 44 min after the last rocuronium administration. Sugammadex (200 mg) was administered intravenously. Seven minutes after the end of surgery, the patient was alert and could lift her head for 5 seconds. At that time, she was extubated. She complained of wound pain and was given acetaminophen (600 mg IV). Her Aldrete score was 9/10 points.

The patient was transferred to the postanesthesia care unit (PACU) for close follow-up. Her axillary body temperature was 36.9°C. She had a normal general condition and normal vital signs while receiving 5 L min⁻¹ O₂ through a face mask for 90 min after arriving at the PACU. Two hours after arriving at the PACU, she showed tachypnoea and no responses to verbal commands or vigorous noxious stimuli. Her arterial blood gas analysis was pH 7.024, PaCO₂ 108 mm Hg, and PaO₂ 205 mm Hg. She was intubated again due to CO₂ narcosis. Fortunately, after the IV administration of 200 mg of sugammadex, her tidal volume increased. She showed responses to ver-

bal commands. However, discussion between the anaesthesia and surgical teams led to the decision to leave the patient intubated until the next morning because the effect and duration of the extravasation of rocuronium were unknown and she had dementia. During that time, she was maintained under controlled ventilation with continuous propofol infusion (35 mg h⁻¹). She was extubated uneventfully the following morning.

The aetiology behind recurarization of rocuronium is likely to be multifactorial. In general, in the case of IV administration of rocuronium, compared to younger patients, it has been recognized that altered pharmacokinetics of NMBAs in elderly patients leads to a prolonged duration of action of these drugs [7]. In addition, it has been reported that underdosing of sugammadex can produce residual rocuronium blockade [8]. Moreover, it should be noted that rocuronium becomes more potent in an acidotic state [9]. Recurarization of rocuronium after extravasation is caused not only by the effects of systemic administration of the drug but also by drug absorption at the site of extravasation [2–5].

In the present case, the effects of systemic administration of the drug were unlikely to be the main cause of recurarization because, at the end of the surgery, her tidal volume in spontaneous breathing was 250 mL. Thus, it is possible that interstitial rocuronium accumulation provided a sequestered repository from which rocuronium might gradually diffuse back into the circulation. Previous studies showed physiological and pathological declines in peripheral blood flow with ageing, and arteriosclerosis may support prolonged effects due to a delay in the absorption of subcutaneous drugs [10–12]. Therefore, it should be noted that the duration of action of subcutaneous rocuronium may be prolonged in elderly patients, especially those with circulatory disorders.

In the case described, the patient was stable at 90 min after the operation, but she showed tachypnoea and

unresponsiveness to verbal commands after approximately 120 min in the PACU. Because sugammadex has a t_{1/2} of approximately 1.8 hours in adult patients with normal renal function, recurarization may have been induced if the absorption of rocuronium continued for 120 min after sugammadex injection [5].

Rapid sequence induction using propofol and rocuronium together was attempted before extravasation was noted. The present case showed oedema of the extremities due to hypoalbuminaemia, and the cannula was inserted in the antecubital fossa area. Moreover, it has been reported that the risk of extravasation is increased in geriatric patients with a reduced ability to communicate [13]. The whole situation could have been avoided at one critical decision point by waiting to verify whether the propofol had successfully induced anaesthesia prior to the administration of rocuronium. Moreover, since the cannula was inserted in the antecubital fossa area and there was oedema in the extremities, it was extremely difficult to detect extravasation by observation. Thus, in cases such as this one, physicians should check for blood backflow before administration [1, 3]. In addition, at the first sign of extravasation, any remaining drug should be aspirated from the cannula [1]. According to our observation of this case, we emphasize that it is necessary to carefully check the patient's IV line before the drug is injected.

Although our patient showed clinical signs such as a 5-second head lift after surgery, it cannot be ruled out that her neuromuscular recovery was inadequate at the time of extubation because the 5-second head lift may be an unreliable sign of full recovery from NMBAs [6, 7]. In our department, especially in emergency cases, not all patients are monitored with neuromuscular monitoring due to the limitations of the technique [14]. However, we emphasize that neuromuscular monitoring should have been considered essential in our patient throughout anaesthesia and into the postop-

erative period, especially following the extravasation of rocuronium.

The present case report describes a rare phenomenon; however, the abovementioned procedure could be improved by confirming a proper fluid volume, avoiding the extravasation of rocuronium, intra- and postoperative neuromuscular monitoring, and more careful postoperative observation. In particular, we emphasize two things: it is important to avoid extravasation of rocuronium and to use neuromuscular monitoring in all cases with extravasation of rocuronium.

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