

Sugammadex Rescue in Avoiding Intensive Care Unit Admission in an Octogenarian Undergoing Emergency Laparotomy

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Postlaparotomy management for elderly patients with underlying comorbidities is always a challenge because of poor cardiorespiratory reserves and prolonged effect of anesthetic drugs. For these reasons, such patients usually require intensive care unit (ICU) admission in the postoperative period. We report a case of an 85-year-old chronic smoker with controlled diabetes mellitus who needed an emergency laparotomy for a perforated gastric ulcer. Unfortunately, there was a shortage of ICU backup. With the successful conduct of an early surgery using combined general and regional anesthesia, the use of sugammadex (Bridion, Merck Sharp & Dohme Corp, Oss, the Netherlands) as a reversal agent, a skilled surgeon, and good post-anesthesia care, the patient did not require ICU admission. He recovered fast and was discharged home 4 days after surgery. This case study aims to contribute to the literature on experience of a successful conduct of anesthesia in a high-risk geriatric patient when ICU facilities are limited.

Keywords: geriatrics, sugammadex, muscle relaxant reversal, perforated gastric ulcer, intensive care.

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MORBIDITY ASSOCIATED WITH general anesthesia is always an issue when dealing with elderly patients.¹ This is largely attributed to underlying comorbidities, poor cardiorespiratory reserves, and the prolonged effect of anesthetic drugs.¹ The condition becomes more challenging when it comes to emergency laparotomy for a perforated viscus.² Therefore, intensive care unit (ICU) admis-

sion after emergency laparotomy for an elderly patient with comorbidity is a routine practice in many institutions.³ A delay of bed availability in the ICU, however, often causes significant morbidity and mortality.^{4,5}

Sugammadex (Bridion, Merck Sharp & Dohme Corp, Oss, the Netherlands) is a novel selective

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relaxant binding agent that can produce rapid and complete reversal of aminosteroid muscle relaxant without causing cholinergic side effects.⁴ It is a reliable alternative to neostigmine as a reversal agent with better cost-effectiveness.⁶ It acts by encapsulating the neuromuscular blocking drug very tightly and forming a stable complex in the plasma until removed from circulation.⁵ With this mechanism, the increased duration of action in rocuronium seen in elderly patients⁷ is no longer a problem.

This article intends to provide an overview of perianesthesia care that might improve outcomes in an actual geriatric patient. To our knowledge, there has been no literature describing the practical use of sugammadex contributing to the successful perioperative management of an unplanned emergency laparotomy in a high-risk geriatric patient when ICU facilities are unavailable.

Perianesthesia Case Study

An 85-year-old, 55 kg gentleman presented with a 1-day history of epigastric pain associated with severe tenderness and guarding. His chest radiograph showed air under the diaphragm, and he was diagnosed to have perforated gastric ulcer (PGU).

The patient had underlying, controlled Type II diabetes. He was also a chronic smoker who had been smoking since the age of 30. However, he did not have many functional limitations. Preoperatively, he was able to climb two flights of stairs and ride a motorbike. On review, he was mildly dehydrated, with a blood pressure (BP) of 106/76 mm Hg and a heart rate of 96 bpm. Central venous pressure was 8 cm H₂O, urine output was 40 mL/hour, but the urine was concentrated. Although having severe tenderness and a mildly distended abdomen, he was afebrile. Total white count was $13.5 \times 10^3/\text{mm}^3$. Venous blood gas showed pH of 7.36, bicarbonate was 21.3 mmol/L, base excess was -3.5 mmol/L, lactate was 1.8 mmol/L, and random blood sugar was 7.4 mmol/L. Chest radiography showed mildly hyperinflated lungs in addition to the finding of air under the diaphragm. There was no cardiomegaly. Bedside ultrasonography revealed the presence of free fluid in the abdomen. In view of his morbidity, he was placed in acute bed in the ward with one-

to-two nursing care. Intravenous fluid therapy was started, and he was kept nil-by-mouth with hourly monitoring of blood sugar level and vital signs. Urine output was also monitored strictly to ensure adequate kidney perfusion.

Surgery was planned for laparotomy and PGU repair. Unfortunately, there was no backup bed in the ICU. The ICU facility in the only nearby tertiary hospital was also full. It became a dilemma whether to first proceed with surgery or to wait for availability of ICU backup. After a multidisciplinary discussion, consensus was reached. A technique of combined general and regional anesthesia would be used perioperatively, with sugammadex as reversal, and the surgery would be performed by a senior surgeon to shorten the duration of surgery.

The patient was called to the operating room immediately for the PGU repair with continuous fluid resuscitation. After preoxygenation, anesthesia was induced with midazolam 3 mg and fentanyl 50 mcg. Once unconscious, cricoid pressure was applied, and intravenous rocuronium 60 mg (1.1 mg/kg) was given. He was intubated with video laryngoscope (Karl Storz, Tuttlingen, Germany) under modified rapid sequence induction with endotracheal tube size of 7.5 mm. Anesthesia was maintained with a sevoflurane concentration of 1.7% to 2%, aiming at minimal alveolar concentration of 0.7.

Postintubation, bilateral ultrasound-guided transverse abdominis plane block with bupivacaine 0.25% (a total of 30 cc) was given as perioperative analgesia. Infusion of remifentanyl 0.05 mcg/kg/minute was administered as adjunct analgesia for visceral coverage. PGU repair was performed. There was a 1×1 cm prepyloric perforation with 200 cc of pus. Peritoneal cavity was washed thoroughly. Primary repair and omental patch repair were done. The surgery was completed in 98 minutes. Vital signs and temperature were stable throughout the procedure. Arterial blood gas showed no acidosis with lactate level of 1.0 mmol/L (Table 1). BP at the end of surgery was 100/70 mm Hg, and heart rate was 95 bpm.

The patient was subsequently transferred to the Phase I postanesthetic care unit (PACU) with one-to-one nursing care for fast weaning. Continuous oxygen saturation (SPO₂) and vital signs

Table 1. Perioperative Blood Gas Analysis

Blood Gas Analysis	Room Air (VBG)	FiO ₂ 0.5 (ABG)	FiO ₂ 0.4 (ABG)	FM O ₂ 5 L/Min (ABG)	FM O ₂ 5 L/Min (ABG)	NPO ₂ 3 L/Min (ABG)
	6.30 p.m.	8.05 p.m.	9.50 p.m.	11.15 p.m.	1.20 a.m.	7 a.m.
pH	7.36	7.48	7.31	7.38	7.42	7.381
pCO ₂	—	29.5	39.6	34.3	31.6	30.7
pO ₂	—	179	128	169	184	91.8
HCO ₃ [−]	21.3	24	19.7	21.1	22	20
BE	−3.5	−1.6	−5.6	−4.3	−3	−3.5
Lactate	1.8	1.2	1.0	1.4	1.4	0.9

VBG, venous blood gas; FiO₂, fraction of inspired oxygen; ABG, arterial blood gas; FM, face mask; NPO₂, nasal prong; HCO₃[−], bicarbonate level; BE, base excess.

were closely monitored. Soon, he regained spontaneous respiration with good tidal volume (7 mL/kg). When the train-of-four count returned to three, he was given a bolus dose of sugammadex 120 mg (2 mg/kg). Subsequently, he opened his eyes and was able to obey commands. He was able to open his mouth and protrude his tongue, and achieved a motor power of at least 4/5 over upper and lower limbs. After being extubated to venturi mask, the patient had good breathing effort and cough reflex. BP was stable within 20% of preanesthetic level, and SPO₂ was 96% under 5 L/minute of face mask oxygen. This resulted in an Aldrete score^{8,9} (Table 2) of at least 9/10. He was comfortable and not in pain, and secretion was minimal. There was neither tachycardia nor postoperative nausea and vomiting. Repeated arterial blood gas showed pH 7.38, pCO₂ 34.3 mm Hg, pO₂ 169 mm Hg, HCO₃ 21.1 mmol/L, base excess −4.3 mmol/L, and lactate 1.4 mmol/L (Table 1). The blood sugar level was also normal.

After 4 hours of monitoring and observation, the patient was discharged back to the acute bed of the ward. Physiotherapy was continued on the ward, and patient-controlled analgesia with fentanyl was used as postoperative analgesia for 1 day before changing to oral paracetamol and tramadol. He continued to do well and was discharged home on the fourth postoperative day. The patient was reviewed in the surgical clinic 2 weeks later and was discharged in good clinical condition.

Discussion

Although the indications for admission to intensive care remain poorly defined,^{3,10} the main indication

for admission in this patient included emergency surgery (perforated viscus) and an advanced age with associated comorbidity, for example, chronic smoker and diabetes.³ Studies have shown that age is a strong predictor for morbidity after a perforated viscus, and the mortality benefit for ICU admission appears greater for the elderly¹¹ because elderly patients have lower drug metabolism and elimination rates, increasing the tendency of incomplete reversal and prolonged residual effect of anesthetic drugs.¹² Elderly patients are also prone to impaired respiratory function and postoperative lung collapse. In a 5-year study among octogenarians undergoing emergency laparotomy, the morbidity is found to be as high as 45%.²

Our center is a major teaching hospital located in a city in the east coast of peninsular Malaysia that provides specialized medical and surgical services. It acts as a tertiary referral center for its immediate vicinity as well as a few neighboring states, serving a population of more than 1 million. It has Level 3 adult ICUs, including a 10-bed general ICU and a 10-bed surgical ICU. The ICUs are constantly in high demand with a proportion of requests having to be refused due to the lack of bed availability. Phase 1 PACU is restricted to two patients at a time and is equally busy, with step-down and telemetry units not currently available.

When there was no backup bed available in the ICU, the authors had some difficulties in deciding whether to proceed with surgery first or to wait for the availability of ICU facilities. The latter should not be encouraged because early diagnosis and early surgery have been shown to improve

Table 2. The Aldrete Score (Modified)

Criteria	Point
Oxygenation	
Able to maintain O ₂ saturation >92% on room air	2
Needs O ₂ inhalation to maintain O ₂ saturation >90%	1
O ₂ saturation < 90% with O ₂ supplement	0
Respiration	
Able to breathe deeply and cough freely	2
Dyspnea or limited breathing	1
Apnea	0
Circulation	
BP $\pm$ 20% of preanesthetic level	2
BP $\pm$ 20% to 49% of preanesthetic level	1
BP $\pm$ 50% of preanesthetic level	0
Consciousness	
Fully awake	2
Arousable on calling	1
Not responding	0
Activity	
Able to move 4 extremities voluntarily or on command	2
Able to move 2 extremities voluntarily or on command	1
Unable to move extremities voluntarily or on command	0

O₂, oxygen; BP, blood pressure.

A score of 9 or greater is required to discharge from postanesthetic care unit.

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outcome in PGU patients,¹³ and fast tracking should be recommended. Therefore, the authors opted for an early surgical intervention, using an effective reversal agent, with transverse abdominis plane block to reduce the systemic opioid use for pain relief. Remifentanyl was used as adjunct intra-operative analgesia for a complete coverage of visceral pain. Recommending a go ahead with an emergency laparotomy for perforated viscus when ICU facilities are unavailable poses a significant risk. If organ dysfunction developed postoperatively, a back-up plan B was available, that is, prolonged stay in Phase I PACU, which is not an optimal patient care.^{14,15}

The overflowing of patients from ICU to the PACU has been a longtime issue.¹⁵ The challenges of diverting ICU patients to PACU include staffing requirements for safe practice, critical care

competencies for the nurses, confusion in physician coverage, disrupting the flow of surgery requiring PACU stay, and even privacy issues. Overflowing of ICU is also believed to affect patient outcomes in the operating room, nursing outcomes such as reduced work satisfaction, and increase the cost of health care in terms of delaying surgery because of inadequate PACU backup.¹⁶

Routine admission to the ICU is also not without risks. Possible risks from overaggressive care include procedure complications, multidrug-resistant infections, and delayed mobilization.¹⁷ Thus, patients should not be admitted to the ICU just for anticipatory monitoring.

Most drugs have an altered property among elderly patients, including neuromuscular blocking drugs and reversal agents. These include altered pharmacokinetics and dynamics, reduction of clearance, and volume of distribution.^{12,18} The prolonged effect of muscle relaxants in elderly patients might be partly due to organ dysfunction.¹ Sugammadex has been shown to reduce postoperative residual curarization, thus promoting a rapid turnover of patients in operating rooms with improved cost-effectiveness.^{19,20} Outcome improvement has also been shown from reports of sugammadex use in patients with kidney, liver, cardiac, respiratory, and neuromuscular diseases.²¹ Recent studies have also shown that the use of sugammadex in the general population is associated with a significant reduction in length and cost of hospitalization.^{22,23}

The traditional reversal technique of using anticholinesterases such as neostigmine in clinical practice has important limitations, especially among the elderly. With the use of neostigmine, an anticholinergic drug, either atropine or glycopyrrolate is required concomitantly to avoid muscarinic side effects such as bradycardia and hypotension. This exposes elderly patients to side effects such as tachycardia, dry mouth, and blurring of vision. With the use of sugammadex, these side effects can be avoided.

Conclusion

We postulated that the use of sugammadex in this patient contributed to the rapid and complete

reversal of respiratory function without side effects. With early intervention, good conduct of anesthesia and good postanesthesia care, the need for postoperative ICU admission was avoided. With this positive outcome, we aim to contribute to the literature on the experience of a successful course of perioperative care in a desperate situation. This condition was unsuitable for any trial to be conducted. This may initiate a research question on whether sugammadex may improve perioperative outcome to the

extent that ICU admission for anticipatory monitoring is no longer required.

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