



General anesthesia without neuromuscular blocking agents using regional blocks in rocuronium-induced anaphylaxis - A case report -

Ji Young Kim¹, Young Chul Yoo¹, Na Young Kim¹,
Hyeon Woo Bae², and Soo Jung Park¹

Received September 9, 2025

Revised October 31, 2025

Accepted November 9, 2025

¹Department of Anesthesiology and Pain Medicine, Anesthesia and Pain Research Institute, ²Division of Colon and Rectal Surgery, Department of Surgery, Severance Hospital, Yonsei University College of Medicine, Seoul, Korea

Corresponding author

Soo Jung Park, M.D.

Department of Anesthesiology and Pain Medicine, Anesthesia and Pain Research Institute, Yonsei University College of Medicine, 50-1 Yonsei-ro, Seodaemun-gu, Seoul 03722, Korea

Tel: 82-2-2228-4430

Fax: 82-2-2227-6517

E-mail: crystal@yuhs.ac

Background: Neuromuscular blocking agents (NMBAs) are the leading cause of perioperative anaphylaxis. In confirmed cases with limited non-cross-reactive options, safe anesthesia requires coordination and muscle relaxant-free strategies.

Case: A 64-year-old woman with confirmed rocuronium-induced anaphylaxis and multiple comorbidities—including poorly controlled diabetes, coronary artery disease, chronic obstructive pulmonary disease, and obesity—underwent laparoscopic anterior resection of the sigmoid colon. General anesthesia was induced and maintained without muscle relaxants using total intravenous anesthesia and regional blocks. Airway topicalization and deep anesthesia enabled smooth intubation. Bilateral transversus abdominis plane and rectus sheath blocks provided effective somatic analgesia and abdominal relaxation. Ventilation and hemodynamic parameters remained stable throughout. The patient recovered uneventfully, without agitation or delayed arousal, and was discharged uneventfully on postoperative day 5.

Conclusions: This report describes the feasibility of NMBA-free general anesthesia using intravenous agents and targeted regional blocks in high-risk patients with confirmed anaphylaxis, even in laparoscopic procedures.

Keywords: Anaphylaxis; Case reports; Colorectal surgery; Neuromuscular blocking agents; Rocuronium; Total intravenous anesthesia; Transversus abdominis plane block.

Although rare, perioperative anaphylaxis poses a serious challenge for anesthesiologists, with neuromuscular blocking agents (NMBAs) as the most frequent culprits [1]. Anaphylactic reactions during anesthesia may rapidly progress to cardiovascular collapse, bronchospasm, or death, requiring prompt recognition and intervention [2,3]. In South Korea, limited availability of non-aminosteroid agents, such as cisatracurium and succinylcholine, complicates anesthetic planning for sensitized individuals. These limitations neces-

sitate the exploration of muscle relaxant-free anesthetic strategies, especially for patients with confirmed NMBA-induced anaphylaxis. Most reports of general anesthesia without muscle relaxants involve minor procedures. By contrast, successful major laparoscopic surgeries under these conditions are rare, especially in patients with multiple comorbidities. Here, we present a case of successful NMBA-free general anesthesia using total intravenous anesthesia (TIVA) and regional blocks in a patient with confirmed rocuroni-

um-induced anaphylaxis.

CASE REPORT

A 64-year-old woman (154 cm, 64 kg; body mass index 27.0 kg/m²) with sigmoid colon cancer was scheduled to undergo a laparoscopic low anterior resection. Comorbidities included hypertension, poorly controlled diabetes mellitus (HbA1c, 10.3%), and chronic kidney disease. She also had mild chronic obstructive pulmonary disease, coronary artery disease, and a history of failed percutaneous coronary interventions. Functional capacity was less than four Metabolic Equivalents of Tasks. She was assigned an American Society of Anesthesiologists physical status class III owing to multiple comorbidities and increased perioperative risk.

One month earlier, the patient had experienced a severe anaphylactic reaction during anesthesia induction with rocuronium at another hospital, resulting in profound hypotension requiring epinephrine and postoperative intensive care.

After recovery, she was referred to the Department of Al-

lergy at our institution for further evaluation. A standardized allergy work-up was performed according to the European Network for Drug Allergy/European Academy of Allergy and Clinical Immunology (ENDA/EAACI) guidelines [4,5], including skin prick testing, intradermal testing, and serum IgE assessment for all perioperative agents used during the prior anesthesia and other commonly used anesthetics. The results demonstrated a strong intradermal reaction to rocuronium, while all other agents tested negative, confirming rocuronium-induced anaphylaxis. The patient was issued an adverse drug reaction alert card and advised to avoid all aminosteroid NMBA due to their high cross-reactivity potential (Fig. 1).

Because benzylisoquinoline NMBA such as cisatracurium were unavailable at our institution, an NMBA-free anesthetic strategy combining TIVA and regional blocks was implemented for the subsequent laparoscopic procedure. In the absence of safe alternative NMBA, the anesthetic plan focused on three goals: (1) ensuring smooth airway management without muscle relaxants via airway topicalization; (2) maintaining effective ventilation during pneumoperito-

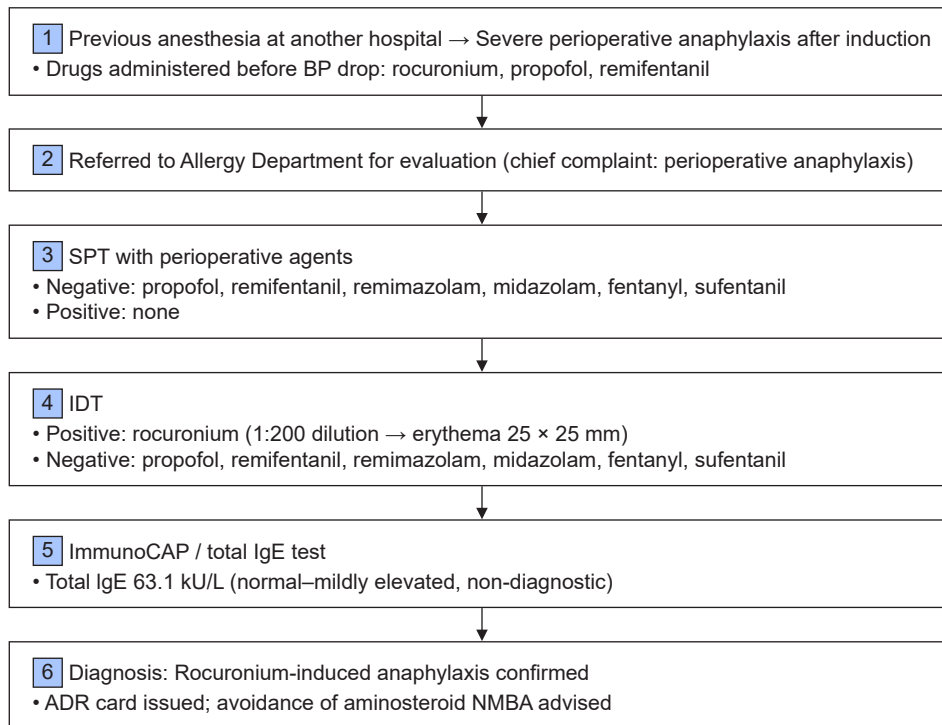


Fig. 1. Diagnostic workflow confirming rocuronium-induced anaphylaxis. The patient, who experienced perioperative anaphylaxis following rocuronium administration, underwent a standardized allergy evaluation. SPT was negative for all agents, while IDT showed a strongly positive response to rocuronium. Rocuronium-induced anaphylaxis was confirmed, and NMBA-free anesthesia was subsequently planned. SPT: skin prick testing, IDT: intradermal testing, ImmunoCAP: fluorescence enzyme immunoassay for allergen-specific IgE, IgE: immunoglobulin E, ADR: adverse drug reaction, NMBA: neuromuscular blocking agent.

neum with adequate regional analgesia; and (3) avoiding hemodynamic instability related to deep anesthesia in patients with cardiovascular comorbidities.

Upon arrival in the operating room, standard monitoring (IntelliVue MX700, Philips Healthcare) was applied, including noninvasive blood pressure, pulse oximetry, electrocardiography, and processed electroencephalography (Patient State Index [PSI]). Her initial vital signs were as follows: blood pressure, 213/76 mmHg; SpO₂ 96%; heart rate, 86 beats per min. To reduce preoperative anxiety and sympathetic overactivity, intravenous midazolam (1 mg) was administered, after which her blood pressure decreased to 107/59 mmHg. An awake arterial line was inserted under local anesthesia for continuous blood pressure monitoring. For airway topicalization, approximately 3–5 puffs (30–50 mg) of lidocaine 10% spray (Sungkwang Pharm Co.) was applied to the oropharynx and the endotracheal tube two minutes before intubation to attenuate gag and cough reflexes [6].

An additional 1 mg of midazolam was given, and general anesthesia was initiated with target-controlled infusion of remifentanyl (GlaxoSmithKline) and 2% propofol (Fresenius Kabi), using the Injectomat TIVA Agilia pump (Fresenius Kabi), with effect-site concentrations (Ce) of 3.0 ng/ml for remifentanyl and 5.0 µg/ml for propofol, respectively. After confirming deep anesthesia and absence of coughing or vocal cord movement, video laryngoscopy was performed, and tracheal intubation was completed using an endotracheal

tube pretreated with a topical anesthetic. A 7-Fr central venous catheter was placed in the right internal jugular vein to prepare for hemodynamic instability.

Following induction, the patient was placed in the supine position, and an ultrasound-guided transversus abdominis plane (TAP) block and rectus sheath blocks (RSB) were performed using an in-plane technique. We used 30 ml of 0.5% ropivacaine (Hanlim Pharm. Co.); 5 ml was injected on each side of the rectus sheath near the pre-marked incision site, and 10 ml was administered bilaterally to the expected port insertion areas (Fig. 2). No complications or adverse effects from regional blocks were observed.

General anesthesia was maintained with remifentanyl (3–5 ng/ml) and propofol (4–5 µg/ml). The patient was ventilated using volume-controlled mechanical ventilation with a tidal volume of 420 ml, respiratory rate of 10 breaths per min, and positive end-expiratory pressure of 7 cmH₂O. Intraoperative hemodynamics were continuously monitored via a radial arterial line, with serial measurements cross-checked against noninvasive blood pressure readings. Mean arterial pressure was maintained at ≥ 70 mmHg and within ± 20% of baseline values throughout the procedure. Heart rate remained between 60 and 80 beats/min without vasopressor requirement. Pneumoperitoneum pressure was maintained at 12 mmHg, with a Trendelenburg position of approximately 25°. Corresponding ventilatory and hemodynamic data were collected concurrently to provide ventilatory mechanics. Airway pressures (peak 18–28 cmH₂O; plateau 15–22

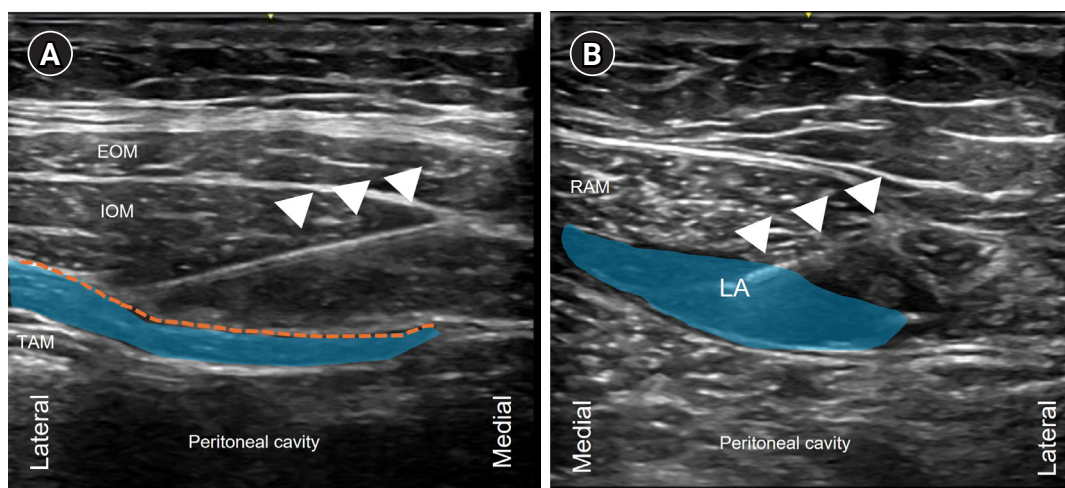


Fig. 2. Ultrasound-guided TAP and RSB. (A) In-plane TAP block with the needle tip positioned between the IOM and TAM. The orange dashed line indicates the site of LA deposition. The LA diffused extensively into the plane between the IOM and TAM. The needle is indicated by the white arrowheads. (B) In-plane RSB at the lateral margin of the RAM, targeting the posterior rectus sheath. The needle is indicated by the white arrowheads. TAP: transversus abdominis plane, RSB: rectus sheath block, EOM: external oblique muscle, IOM: internal oblique muscle, TAM: transversus abdominis muscle, LA: local anesthetic, RAM: rectus abdominis muscle.

cmH₂O) and dynamic compliance (18–26 ml/cmH₂O) remained stable, with end-tidal carbon dioxide–arterial partial pressure of carbon dioxide (PaCO₂) (EtCO₂–PaCO₂) gradients ≤ 6 mmHg, indicating adequate ventilation and preserved pulmonary compliance under pneumoperitoneum and Trendelenburg positioning (Table 1). The PSI was maintained between 17 and 28, indicating an adequate anesthetic depth. The patient's hemodynamic status remained stable without the need for vasopressors. Throughout the procedure, the operating surgeon evaluated the quality of the intra-abdominal workspace using a five-point Surgical Rating Scale (SRS) (1 = extremely poor, 2 = poor, 3 = acceptable, 4 = good, 5 = optimal), adapted from validated laparoscopic scoring systems [7,8]. The SRS was assessed at four key stages: (1) after umbilical port insertion, (2) upon laparoscope placement, (3) after establishment of the Trendelenburg position and pneumoperitoneum, and (4) during specimen retrieval at the end of surgery. The average score across all time points was used to represent overall surgical field adequacy. The mean surgeon-rated SRS was 4.3 ± 0.5 ('good conditions') across all intraoperative stages, confirming that adequate workspace and surgical visibility were achieved despite the absence of neuromuscular blockade.

Near the end of surgery, the surgeon noted mild discomfort during specimen retrieval with an SRS score of 3; however, no intervention was required. Stage-specific SRS scores were recorded and are presented in Table 1. To enhance postoperative pain control, 8 µg of sufentanil was administered intravenously during surgical closure.

The total anesthesia and surgical durations were 205 and 140 min, respectively, with an estimated blood loss of 20 ml. During anesthesia, 0.2 mg remifentanyl and 600 mg (2%) propofol were administered via target-controlled infusion, and 8 µg sufentanil was given intravenously at closure for

postoperative analgesia.

In the post-anesthesia care unit, the patient was hemodynamically stable and reported mild pain (numeric rating scale 2/10). No rescue analgesics or antiemetics were required, and the patient was discharged after 35 min of recovery.

In the ward, pain was well controlled with intravenous patient-controlled analgesia (PCA) containing fentanyl 1,000 µg and ramosetron 0.6 mg diluted in 100 ml of normal saline (basal rate: 2 ml/h; bolus: 1.5 ml; lockout interval: 15 min). Pain scores were 3/10 at 6 h and 2/10 at 24 h, with a total opioid use of approximately 22 mg morphine equivalent. Mild nausea at 12 h resolved after temporary PCA suspension and intravenous pethidine 25 mg. Intravenous 300 mg ibuprofen and 1 g acetaminophen (Maxigesic IV, Kyongbo Pharm) were continued thereafter.

The patient was discharged on postoperative day 5 without respiratory or other complications.

All clinical data were retrospectively collected from the electronic medical records system. Written informed consent was obtained from the patient for publication, and the study was approved by the Institutional Review Board (IRB) of Severance Hospital, Yonsei University College of Medicine (IRB No. 4-2025-0600).

DISCUSSION

Avoiding NMBA-induced anaphylaxis is crucial due to its rapid onset, unpredictability, and potentially fatal nature, with high cross-reactivity and often no prior warning [3]. Although rare (approximately 3.8 per 100,000 rocuronium administrations in a large Korean cohort), NMBA remain among the most commonly implicated drug classes for perioperative anaphylaxis [2]. Notably, approximately 56%

Table 1. Intraoperative Parameters and Surgeon-Rated Surgical Field Scores

Intraoperative stage	Pneumoperitoneum (mmHg)	Trendelenburg position (°)	PIP/plateau (cmH ₂ O)	Dynamic compliance (ml/cmH ₂ O)	EtCO ₂ /PaCO ₂ (mmHg)	SRS (1–5)
Umbilical port insertion	-	0	18/15	26	33/38	4
Laparoscope placement	12	10	24/19	22	34/40	5
Laparoscopic Trendelenburg	12	25	28/22	18	36/42	5
Specimen retrieval	12	10	25/20	20	32/38	3

Values are presented as representative intraoperative averages at each procedural stage. -: not available, PIP: peak inspiratory pressure, EtCO₂: end-tidal carbon dioxide, PaCO₂: partial pressure of carbon dioxide, SRS: surgical rating scale.

of patients with rocuronium-induced anaphylaxis also test positive for other aminosteroid agents such as vecuronium, emphasizing the difficulty of selecting safe alternatives [3].

This case highlights the challenges of managing confirmed NMBA-induced anaphylaxis in settings with limited access to non-cross-reactive alternatives. In such situations, muscle relaxant-free general anesthesia using intravenous agents and regional techniques is a feasible approach.

Neuraxial anesthesia (e.g., spinal or combined spinal-epidural) was initially considered to avoid muscle relaxants. However, due to the surgeon's preference for a minimally invasive approach and the limited applicability of neuraxial techniques to laparoscopic low anterior resection, general anesthesia was selected.

To ensure safe airway management without neuromuscular blockade, we implemented multiple reflex suppression strategies. Lidocaine spray was applied to the oropharynx and endotracheal tube to reduce mucosal irritation. Midazolam was administered before induction to reduce preoperative anxiety and sympathetic tone. These measures, alongside deep anesthesia, helped suppress airway reflexes and sympathetic surges during intubation. Endotracheal intubation was completed without any patient movement or hemodynamic instability.

TIVA was chosen over volatile agents due to its favorable profile in patients with multiple comorbidities [9]. Propofol suppresses spinal motor neuron excitability and, when combined with remifentanyl, reduces somatic responses while maintaining stable anesthetic depth [10]. This combination has also been shown to provide superior muscle relaxation compared with volatile agents with remifentanyl, particularly in the absence of NMBAs [9,10]. TIVA minimizes airway irritation and sympathetic stimulation—crucial during laparoscopic surgery. In this case, the patient's comorbidities, including chronic obstructive pulmonary disease, poorly controlled diabetes, obesity, and coronary artery disease, posed a risk of compromised pulmonary and cardiovascular stability during pneumoperitoneum and Trendelenburg positioning. Intraoperative ventilatory and hemodynamic parameters remained stable throughout.

A deep neuromuscular block facilitates laparoscopic surgery by enhancing abdominal compliance and enabling low-pressure pneumoperitoneum [11]. Similar effects can be partially achieved using regional techniques in patients in whom NMBAs are contraindicated. In this case, we selected 0.5% ropivacaine for both TAP and RSB based on previous randomized studies showing its superior analgesic effect

compared to lower concentrations in laparoscopic abdominal surgery [12,13]. The TAP block provides extensive lateral abdominal analgesia by targeting the neurofascial plane between the internal oblique and transversus abdominis muscles, covering dermatomes T6–L1 [12]. To complement this, RSB was performed bilaterally at the incision site while anesthetizing the terminal branches of the lower thoracic nerves passing through the posterior rectus sheath [13]. This combined approach allowed for both lateral and midline abdominal wall relaxation, facilitating adequate trocar access and minimizing somatic pain. Although the surgeon reported mild resistance during specimen retrieval, the patient did not experience postoperative somatic pain at the incision site, further confirming the effectiveness of the multimodal regional technique.

Previous reports have shown that either TIVA or regional anesthesia alone can be used in patients with NMBA anaphylaxis. However, our case demonstrates the complementary value of combining these techniques [14,15]. Depth-guided TIVA, meticulous airway topicalization, and multimodal abdominal wall blocks (including TAP and RSB) together provided adequate anesthetic depth, hemodynamic stability, and abdominal wall relaxation, enabling laparoscopic surgery without the need for neuromuscular blockade.

Continuous depth monitoring (e.g., PSI), comprehensive hemodynamic and ventilatory assessment, together with surgeon-rated surgical conditions, provided objective intraoperative evidence supporting the physiological stability and reproducibility of this NMBA-free anesthetic approach.

While this report describes a single high-risk patient managed at a specialized tertiary center, this protocol may be applied to carefully selected patients and surgical settings. Although its applicability will vary depending on patient factors, surgical requirements, and institutional experience, it provides a practical and structured clinical framework that may guide future practice and support prospective evaluation of NMBA-free anesthesia.

In conclusion, this case demonstrates that major laparoscopic surgery can be performed safely without neuromuscular blockers in patients with confirmed NMBA-induced anaphylaxis, using a tailored multimodal strategy that incorporates airway topicalization, depth-guided TIVA, and regional anesthesia.

FUNDING

None.

CONFLICTS OF INTEREST

No potential conflict of interest relevant to this article was reported.

DATA AVAILABILITY STATEMENT

The datasets generated during and/or analyzed during the current study are available from the corresponding author on reasonable request.

AUTHOR CONTRIBUTIONS

Conceptualization: Ji Young Kim, Soo Jung Park. Data curation: Ji Young Kim, Soo Jung Park. Project administration: Young Chul Yoo, Soo Jung Park. Visualization: Ji Young Kim. Writing - original draft: Ji Young Kim, Soo Jung Park. Writing - review & editing: Ji Young Kim, Young Chul Yoo, Na Young Kim, Hyeon Woo Bae, Soo Jung Park. Resources: Na Young Kim. Supervision: Young Chul Yoo. Validation: Young Chul Yoo.

ORCID

Ji Young Kim, <https://orcid.org/0000-0002-2844-0652>
 Young Chul Yoo, <https://orcid.org/0000-0002-6334-7541>
 Na Young Kim, <https://orcid.org/0000-0003-3685-2005>
 Hyeon Woo Bae, <https://orcid.org/0000-0002-8140-8176>
 Soo Jung Park, <https://orcid.org/0000-0001-9199-7157>

REFERENCES

- Hepner DL, Castells MC. Anaphylaxis during the perioperative period. *Anesth Analg* 2003; 97: 1381-95.
- Cho YJ, Ju JW, Sim H, Lee JH, Hong DM, Kim TK, et al. Intraoperative anaphylaxis to neuromuscular blocking agents: the incidence over 9 years at two tertiary hospitals in South Korea: a retrospective observational study. *Eur J Anaesthesiol* 2016; 33: 368-78.
- Sadleir PH, Clarke RC, Bunning DL, Platt PR. Anaphylaxis to neuromuscular blocking drugs: incidence and cross-reactivity in Western Australia from 2002 to 2011. *Br J Anaesth* 2013; 110: 981-7.
- Brockow K, Garvey LH, Aberer W, Atanaskovic-Markovic M, Barbaud A, Bilo MB, et al. ENDA/EAACI Drug Allergy Interest Group. Skin test concentrations for systemically administered drugs -- an ENDA/EAACI Drug Allergy Interest Group position paper. *Allergy* 2013; 68: 702-12.
- Mertes PM, Malinovsky JM, Jouffroy L, Aberer W, Terreehorst I, Brockow K, et al. Reducing the risk of anaphylaxis during anesthesia: 2011 updated guidelines for clinical practice. *J Investig Allergol Clin Immunol* 2011; 21: 442-53.
- Fjærestad T, Øyrås P, Solbakk KI, Leonardsen AL. Upper airway discomfort: a randomized controlled double-blind trial comparing rocuronium and lidocaine spray for intubation. *Eur J Med Res* 2025; 30: 498.
- Boon M, Martini CH, Aarts LPHJ, Dahan A. The use of surgical rating scales for the evaluation of surgical working conditions during laparoscopic surgery: a scoping review. *Surg Endosc* 2019; 33: 19-25.
- Martini CH, Boon M, Bevers RF, Aarts LP, Dahan A. Evaluation of surgical conditions during laparoscopic surgery in patients with moderate vs deep neuromuscular block. *Br J Anaesth* 2014; 112: 498-505.
- Schraag S, Pradelli L, Alsaleh AJO, Bellone M, Ghetti G, Chung TL, et al. Propofol vs. inhalational agents to maintain general anaesthesia in ambulatory and in-patient surgery: a systematic review and meta-analysis. *BMC Anesthesiol* 2018; 18: 162.
- Kakinohana M, Fuchigami T, Nakamura S, Kawabata T, Sugahara K. Propofol reduces spinal motor neuron excitability in humans. *Anesth Analg* 2002; 94: 1586-8. table of contents.
- Bruintjes MH, van Helden EV, Braat AE, Dahan A, Scheffer GJ, van Laarhoven CJ, et al. Deep neuromuscular block to optimize surgical space conditions during laparoscopic surgery: a systematic review and meta-analysis. *Br J Anaesth* 2017; 118: 834-42.
- Murouchi T, Iwasaki S, Yamakage M. Chronological changes in ropivacaine concentration and analgesic effects between transversus abdominis plane block and rectus sheath block. *Reg Anesth Pain Med* 2015; 40: 568-71.
- Petersen PL, Stjernholm P, Kristiansen VB, Torup H, Hansen EG, Mitchell AU, et al. The beneficial effect of transversus abdominis plane block after laparoscopic cholecystectomy in day-case surgery: a randomized clinical trial. *Anesth Analg* 2012; 115: 527-33.
- Paek CM, Yi JW, Lee BJ, Kang JM. No supplemental muscle relaxants are required during propofol and remifentanyl total intravenous anesthesia for laparoscopic pelvic surgery. *J Laparosc Adv Surg Tech A* 2009; 19: 33-7.
- Hong KY, Kim DK, Park HJ, Sim WS, Wi WG, Lee WY, et al. Analgesic efficacy of preemptive transversus abdominis plane block in patients undergoing laparoscopic colorectal cancer surgery. *J Clin Med* 2020; 9: 1577.