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ORIGINAL ARTICLE

Ultrasound-guided bilateral rectus sheath block reduces early postoperative pain after laparoscopic gynecologic surgery: a randomized study

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Abstract

Purpose Rectus sheath block (RSB) is an anterior abdominal wall block that reduces postoperative pain associated with midline incisions. This study aims to investigate the effect of ultrasound-guided bilateral RSB (US-BRSB) on postoperative pain and analgesic consumption in patients undergoing laparoscopic gynecologic surgery.

Methods Sixty patients who underwent laparoscopic gynecologic surgery were allocated to RSB ($n = 30$) or control ($n = 30$) group. A bilateral US-BRSB procedure (30 ml of 0.25% ropivacaine) was performed after induction of general anesthesia in the RSB group. The control group proceeded the surgery without sham block. All patients received fentanyl-based intravenous patient-controlled analgesia and rescue analgesics upon demand. Pain was scored by a blinded observer using a verbal numerical rating scale (VNRS) at rest while coughing at 0, 1, 6, 12, 24, and 48 h after postanesthesia care unit (PACU) admission. The primary outcome was the total number of rescue analgesics used in the 48-h postoperative period.

Results At 0 h, VNRS were lower in the RSB group than in the control, both at rest (median VNRS 4.5 vs. 5, $p = 0.02$) and while coughing (median VNRS 6 vs. 7, $p = 0.004$). At 6 h, VNRS scores were lower in the RSB group than in the control while coughing (median VNRS 3 vs. 5, $p = 0.01$). Fentanyl use as rescue analgesics in the PACU was significantly lower in the RSB group than in the control (27.7 ± 32.1 vs. 53.3 ± 33.7 μg, respectively; $p = 0.004$). At 48 h postoperatively, the total number of rescue analgesics administered were significantly fewer in the RSB group than in the control (2.5 ± 2.5 vs. 3.9 ± 2.6, respectively; $p = 0.04$).

Conclusion US-BRSB reduces the immediate postoperative pain and opioid consumption during the early postoperative period.

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Keywords Laparoscopic surgery · Postoperative pain · Rectus sheath block

Introduction

In surgeries involving the anterior abdominal wall, the role of abdominal wall block is increasing as a part of multimodal analgesic method for postoperative pain control. Rectus sheath block (RSB) is a simple and easily applicable abdominal wall block. Local anesthetic is deposited between the rectus muscle and its posterior sheath, which blocks the anterior cutaneous branches of the lower thoracic spinal nerves (T7–T12). This technique was introduced in 1899 and used for surgical anesthesia and muscle relaxation, but has been neglected due to the development of neuromuscular blocking agents [1]. Smith et al. demonstrated a reduction in postoperative pain in patients who received bilateral rectus sheath block (BRSB) during diagnostic

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laparoscopy compared to a control group [1]. The subsequent development of ultrasound (US)-guided nerve block has led to the rise of US-guided BRSB (US-BRSB), which has been investigated in the context of various abdominal procedures, including pediatric umbilical hernia repair and myomectomy, with both pain-reducing and opioid-sparing effects [2–6].

Several trials have examined the effects of transversus abdominis plane (TAP) block, which represents another classical type of anterior abdominal wall block, during laparoscopic surgery [7–10]. The results of these trials revealed beneficial effects of TAP block on pain reduction and opioid usage, but these effects were relatively small and observed only during the early postoperative period. Multi-port laparoscopic surgery typically involves three to four incisions. The umbilical or periumbilical incision, into which a laparoscope is usually inserted with a large-bore trochar, requires peritoneal and fascial closures, whereas the other incisions can be closed with skin sutures (that may or may not be subcutaneous). We thought that, because the umbilical incision represents the most painful incision site, and because RSB focuses on the midline, RSB may be useful in decreasing the pain caused by umbilical incision. Furthermore, because the distribution of RSB can extend to the anterior superior iliac spine (ASIS), it might be possible to reduce pain from other port incisions as well [11, 12]. Few studies have been published on RSB during laparoscopic surgery [5, 13], but the available results demonstrate lower pain scores during the early postoperative period (up to 10 h).

In the present study, we applied US-BRSB during multiport laparoscopic gynecologic surgery and investigated the effect of US-BRSB on postoperative pain. We hypothesised that US-BRSB would be associated with reduced pain during the early postoperative period, which would, therefore, also reduce analgesic consumption.

Methods

The study used a prospective, randomized, observer-blinded clinical trial design and was carried out after obtaining ethical approval from the institutional review board of our hospital (EUMC 2014-07-006-001) was provided by the Ewha Womans University Mokdong Hospital, Seoul, Korea on 29 October 2014. Written informed consent was obtained from all patients. The protocol for this clinical trial was registered at ClinicalTrials.gov (NCT02476799). Patients aged from 21 to 60 years, who were scheduled to undergo laparoscopic gynecologic surgery, were recruited. Patients were excluded if there was a history of prior abdominal surgery, long-term opioid use, hypersensitivity to ropivacaine, coagulopathy, or infection at the needle insertion site. Patients with an American Society of Anesthesiologists physical status (ASA PS) classification of III or greater, the inability to provide a pain score, or with suspected gynecologic cancer were also excluded.

Patients were allocated to one of two groups by a computer-generated randomized sequence table: one group underwent US-BRSB with 0.25% ropivacaine (RSB group, $n = 30$) and the other group received standard care without US-BRSB (control group, $n = 30$).

All patients received standard general anesthetic management. Non-invasive blood pressure, electrocardiography, pulse oximetry, and capnometry were applied. After premedication with glycopyrrolate (0.2 mg) and midazolam (0.05 mg/kg), general anesthesia was induced with thiopental sodium (4 mg/kg), fentanyl (1–2 μg/kg), and rocuronium (0.6 mg/kg), followed by mask ventilation for 90 s and intubation. Anesthesia was maintained with nitrous oxide, oxygen, and sevoflurane. Sevoflurane was maintained at a volume of 2% during surgery; in addition, fentanyl (0.5–1 μg/kg) was injected to maintain blood pressure and heart rate to within 20% of the first blood pressure and heart rate after arriving in the operating room. End-tidal carbon dioxide (CO_2) was maintained at 30–35 mmHg.

When vital signs had stabilized after intubation, an experienced anesthesiologist, who had previously performed RSB more than 30 times, performed RSB under US guidance using a 38-mm, 6–13 MHz linear transducer of a Sonosite M-Turbo US device (Sonosite®, Bothell, WA, USA). After placing the transducer immediately lateral to the umbilicus in transverse position, a 22-gauge Tuohy needle was inserted medial to the transducer using the in-plane technique and advanced to lateral to introduce 15 ml of 0.25% ropivacaine between the posterior shach of the rectus muscle and its posterior sheath [3, 4] 4. The procedure was performed bilaterally. Following the procedure, surgical preparation proceeded and there was at least a 15-min interval between the RSB procedure and skin incision.

All patients were provided with intravenous patient-controlled analgesia (IV-PCA) after the surgery and maintained for 48 h postoperatively in the ward as follows: 800 μg of fentanyl in a 100-ml volume, which contained 0.3 mg of ramosetron hydrochloride (0.5 ml/h continuous infusion rate), 1-ml bolus infusion, and a 15-min lock-out interval using the portable IV-PCA pump, Accumate 1100 (Woo Young Medical Co., Ltd., Chungbuk, Republic of Korea). On arrival in the postanesthesia care unit (PACU), all patients were reminded that they could request additional analgesics. Upon patient request, 0.5 μg per body weight (kg) of fentanyl was intravenously (IV) injected as a rescue analgesic. To prevent postoperative nausea and vomiting, 0.3 mg of ramosetron hydrochloride was injected at the end of the operation, mixed with IV-PCA as described above, and then injected again to all patients on the first day after surgery.

Pain intensity was assessed twice in the PACU: on arrival at the recovery room (time 0) and after 1 h (time 1), using a verbal numerical rating scale (VNRS: 0 = no pain, 10 = the most severe pain imaginable). A blinded interviewer performed all VNRS assessments, and pain was scored under two conditions: at rest (VNRSr) while coughing (VNRSc). Episodes of nausea/vomiting and dizziness were also recorded. Following transfer to the ward, the blinded interviewer obtained the VNRSr and VNRSc scores at 6, 12, 24, and 48 h postoperatively and an IV injection of ketorolac (30 mg) was used as a rescue analgesic instead of fentanyl. All analgesics administered in the PACU and the ward were recorded in terms of doses and time given. The time to the first rescue analgesic was also recorded. After 48 h postoperatively, IV-PCA data were downloaded to a computer. The IV-PCA pump what we used could record time and number of bolus attempts (button pushes) as well as time and number of the actual injected bolus. Total infused volume, number of bolus attempts, and actual number of boluses given via IV-PCA were collected for data analysis.

Statistical analysis

The primary outcome was the total number of rescue analgesics used in the 48-h postoperative period including both of the fentanyl in the PACU and the ketorolac in the ward. Assuming that the control group would require twice the volume of rescue analgesics as the RSB group, a power analysis based on 90% power with a type I error of 0.05 determined that we needed to include 27 patients in each group. Assuming a 10% drop out rate, it was calculated that 30 patients were required in each group. Statistical analyses were performed using the SPSS for Windows software package (ver. 18.0; SPSS Inc., Chicago, IL, USA). Pain scores at each time period were compared using the Mann–Whitney *U* test. Data on the total number of rescue analgesics, intraoperative fentanyl doses, fentanyl doses in the PACU as the rescue analgesics, IV-PCA data, and total postoperative fentanyl consumption were analysed using Student's *t* test. Kaplan–Meier survival analysis was used to compare groups regarding time to request the first rescue analgesic. Categorical variables were compared using Chi-square analysis or Fisher's exact test. For all tests, a p value < 0.05 was taken to indicate statistical significance.

Results

A total of 336 patients were assessed in terms of their eligibility for inclusion in the study from November 2014 to May 2015. Finally, 60 patients were enrolled and analysed (Fig. 1). There were no group differences in patient characteristics or operative data (Table 1).

Pain scores at 0 h postoperatively were significantly lower in the RSB group compared to the control group, both while at rest ($p = 0.02$) and while coughing ($p = 0.004$). VNRSc at 6 h was lower in the RSB group than in the control group ($p = 0.01$). No significant difference was observed between groups at any other timepoint (Table 2).

Intraoperative fentanyl doses were similar in both groups (Table 3). However, the amount of fentanyl as rescue analgesics in the PACU and total fentanyl doses consumed in the PACU including both doses of rescue and IV-PCA was significantly lower in the RSB group than in the control group ($p = 0.004$ and 0.004, respectively). In addition, a proportion of patients who received fentanyl as a rescue analgesic in PACU was significantly lower in the RSB group than the control group ($p = 0.04$). Although the total amount of fentanyl used postoperatively showed a downward tendency in the RSB group relative to the control group, the group difference was not significant (Fig. 2). Regarding the IV-PCA data, no significant difference was observed between groups with respect to total infused volume, number of bolus attempts, or actual number of boluses given (Table 3). In the aspects of nausea/vomiting and dizziness, there were no significant differences between two groups in the number of patients who complained these symptoms at all timepoints (Table 3).

The median time to request the first rescue analgesic was prolonged in the RSB group compared to the control group (35 vs. 10 min, $p < 0.001$). Four patients in the RSB group did not request any rescue analgesic during the 48-h follow-up (Fig. 3). The cumulative number of rescue analgesics used was significantly lower in the RSB group compared to the control group at all timepoints (Fig. 4). However, total postoperative fentanyl consumption including IV-PCA dose was not significantly different between two groups (307.9 ± 103.4 μg in the control group vs. 274 ± 124.0 μg in the RSB group, $p = 0.31$). In addition, the difference in total dose of administered ketorolac was not significant (68.0 ± 63.5 mg in the control group vs. 53.0 ± 60.4 mg in the RSB group, $p = 0.35$).

There were no adverse events associated with US-BRSB, such as systemic toxicity, peritoneal puncture, or damage to internal organs.

Discussion

This study described the effects of US-BRSB on early postoperative pain after multi-port laparoscopic gynecologic surgery. Upon arrival at the PACU, pain intensity in the RSB group was lower compared to the control group. VNRSc scores at 6 h postoperatively were also lower in the RSB group. Opioid consumption in the PACU at 1 h was significantly lower in the RSB group and more patients of the RSB group did not request rescue analgesics in PACU.

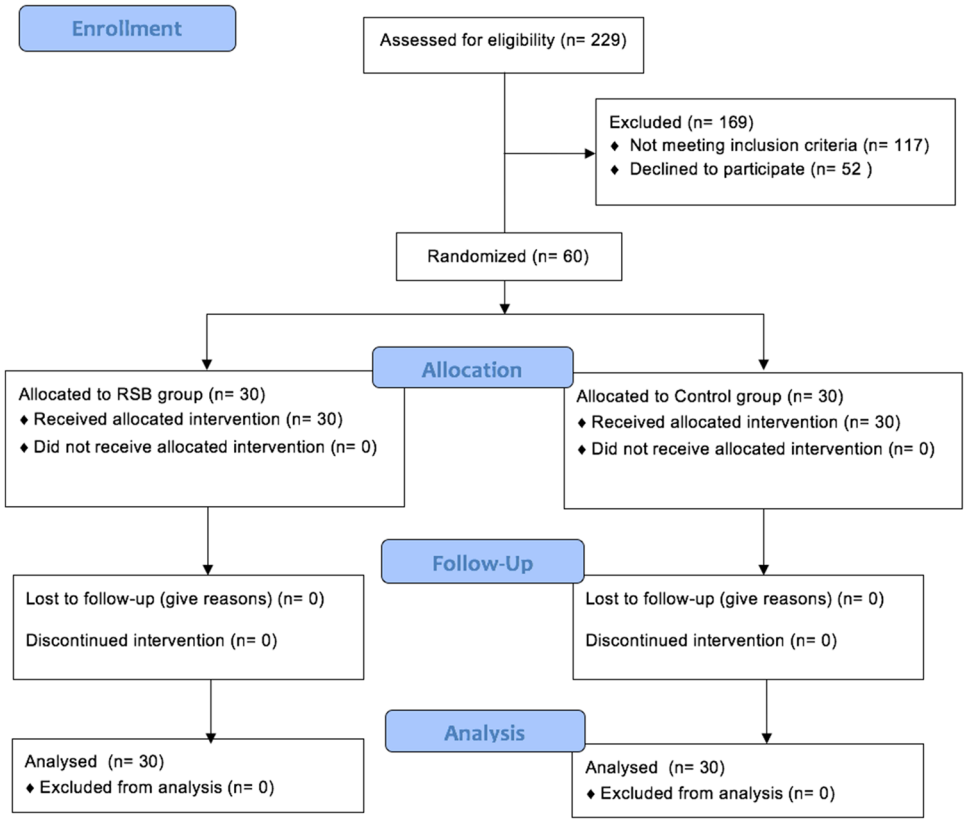

Fig. 1 Study flow diagram for patient recruitment in the trail

Table 1 Demographic data

	Control group ($n = 30$)	RSB group ($n = 30$)	p value
Age (years)	41.7 ± 11.3	39.6 ± 9.8	0.44
ASA PS (I/II)	18/12	20/10	0.59
Height (cm)	161.0 ± 5.9	161.3 ± 5.9	0.86
Weight (kg)	61.0 ± 10.6	58.9 ± 9.3	0.43
BMI (kg/m^2)	23.5 ± 4.1	22.6 ± 3.2	0.34
Operation type			0.56
Ovary	13	16	
Hysterectomy	13	9	
Myomectomy	4	5	
Adhesiolysis (yes/no)	11/19	13/17	0.60
Operation time (min)	91.8 ± 55.5	80.8 ± 27.0	0.33
Anesthesia time (min)	127.5 ± 56.4	118.5 ± 27.3	0.43

Results are expressed as mean ± SD or number of patients

The RSB group received ultrasound-guided bilateral rectus sheath block (US-BRSB) with 30 ml of 0.25% ropivacaine

RSB rectus sheath block, *ASA PS* American Society of Anesthesiologists physical status classification, *BMI* Body Mass Index

However, no difference was observed between groups in terms of the IV-PCA data, while the cumulative number of rescue analgesics was significantly lower in the RSB group at all timepoints.

Pain management during the immediate postoperative period is critical, because inadequate pain control is associated with pulmonary or cardiac complications and increased morbidity and mortality [14]. Furthermore, the severity of

Table 2 Group comparison of verbal numerical rating scale (VNRS) scores

	Control group ($n = 30$)	RSB group ($n = 30$)	p value
Resting			
0 h	5 (2–10)	4.5 (0–7)	0.02
1 h	4 (1–8)	3 (0–7)	0.18
6 h	3 (0–6)	2 (0–7)	0.06
12 h	2 (0–4)	1 (0–6)	0.21
24 h	1 (0–4)	1 (0–4)	0.72
48 h	1 (0–4)	1 (0–3)	0.72
Coughing			
0 h	7 (2–10)	6 (0–8)	0.004
1 h	5 (2–9)	5 (0–8)	0.17
6 h	5 (1–7)	3 (0–8)	0.01
12 h	3 (1–6)	2 (0–8)	0.12
24 h	2 (1–7)	2 (0–5)	0.43
48 h	2 (0–8)	2 (0–4)	0.57

Results are expressed as median (range) values

The RSB group received ultrasound-guided bilateral rectus sheath block (US-BRSB) with 30 ml of 0.25% ropivacaine

RSB rectus sheath block

postoperative pain affects postoperative quality-of-life and enhanced recovery [15–18]. Emotional state in the perioperative period is related to the degree of persistent pain after surgery [19]; this demonstrates the importance of careful management of postoperative pain.

It appears clear from the previous studies that RSB reduces pain during the early postoperative period. Willschke et al. [2] and Gurnaney et al. [3] both reported a reduction in opioid use during the early postoperative period in RSB patients who underwent pediatric umbilical hernia repair surgery. In a study by Dingeman et al. [4], the pain scores of pediatric umbilical hernia repair patients were decreased in the PACU, but were similar to those obtained 4 h postoperatively. However, unlike umbilical hernia repair surgery, the laparoscopic surgery has manipulations on viscera and is accompanied by postoperative visceral pain. Nevertheless, the RSB plays a certain role in reduction of pain also in laparoscopic surgeries. Smith et al. [1] and Azemati et al. [5] observed lower visual analogue pain scores at 10 h in gynecologic laparoscopic patients who received RSB without ultrasound guidance. In a recent trial by Hamill et al. [13], lower pain scores were observed in RSB patients undergoing pediatric laparoscopic appendicectomy at three postoperative hours, but there was no significant reduction in pain thereafter. In addition, Kamei et al. [20] observed reduced pain after single-incision laparoscopic cholecystectomy until six postoperative hours.

We chose the number of rescue analgesics as the primary outcome while comparable studies picked opioid consumption or pain scores. We thought that the severe pain requiring additional drug could be an index of how the patients were suffering and there was a possibility of underestimation of VNRS by the timing or effect of analgesics. In our study, the resting pain (VNRSr) was significantly different only at 0 h and no significant difference in pain score was observed at 1 h postoperatively: this might be due to the use of fentanyl, which has a fast onset time, as a rescue analgesic in the PACU. The coughing pain which reflected abdominal wall stimulation was reduced until 6 postoperative hours. These results are consistent with those of the previous studies [1–5, 13, 20]. However, the difference of median value of VNRS was ranged 1–2 and the difference of opioid consumption during 48 postoperative hours was small (about 30 μg) and insignificant. Therefore, the clinical importance of these results should be taken carefully.

Hamill et al. [13] suggested that the umbilical port is responsible for a high proportion of early postoperative pain and Topcu et al. [21] suggested that incisional pain may be principally responsible for this effect during the early postoperative period after gynecologic laparoscopy. These suggestions are consistent with our own hypotheses and results. Residual pain in the RSB group may have arisen from the viscera due to uterine manipulation and adhesiolysis which is occasionally accompanied. Smith et al. [1] and Topçu et al. [22] reported that RSB during sterilisation was less effective than during diagnostic laparoscopy due to deep pelvic pain, which was alleviated using a mesosalpinx block. Therefore, the use of RSB may be valuable as part of a multimodal analgesia regimen for abdominal surgeries involving midline incision.

Delayed increments in the effect site concentration of fentanyl during IV-PCA may result in insufficient pain control in the immediate postoperative period, which explains why patients sometimes suffer from high-intensity postoperative pain despite IV-PCA. The time taken to reach a steady-state effect site concentration is more than 10 h [23, 24]. RSB can soothe pain before the steady state is reached, and when the action of RSB has ended, fentanyl-based IV-PCA can play a role (because the effect site concentration may have reached a steady state by that time). Therefore, a combination of RSB and IV-PCA may produce a satisfactory outcome, and may represent a reasonable strategy for multimodal analgesia. In fact, our results revealed lower coughing pain at 0 and 6 h in the RSB group compared to controls, and similar pain scores for each group after 12 h.

Because all of the patients were female, and many were also non-smokers, we speculated that the risk of postoperative nausea and vomiting (PONV) during gynecologic surgery might have been elevated. We also assumed that RSB would reduce opioid consumption and could also result in a lower incidence of PONV. However, our results did not corroborate these hypotheses. To address visceral pain, we used

Table 3 Intravenous patient-controlled analgesia (IV-PCA) and rescue analgesic data

	Control ($n = 30$)	RSB ($n = 30$)	p value
Intraoperative fentanyl doses (μg)	133.2 ± 49.3	136.3 ± 40.6	0.81
Rescue analgesics in PACU (no/yes)	4/26	11/19	0.04
Fentanyl doses in PACU as rescue analgesics (μg)	53.0 ± 33.7	27.7 ± 32.1	0.004
Total fentanyl doses in PACU including rescue analgesics and IV-PCA (μg)	64.3 ± 37.5	36.0 ± 35.7	0.004
Total postoperative fentanyl consumption (μg)	307.9 ± 130.4	274.4 ± 124.0	0.31
Total postoperative ketorolac consumption in the ward (mg)	68.0 ± 63.5	53.0 ± 60.4	0.35
Time to the first rescue analgesic (min)	10.0	35.0	< 0.001
Total infused dose of fentanyl via IV-PCA (μg)			
1 h	12.6 ± 8.0	9.8 ± 6.9	0.16
6 h	71.7 ± 41.2	58.4 ± 31.6	0.18
12 h	108.4 ± 58.3	91.5 ± 45.9	0.23
24 h	166.8 ± 76.6	157.0 ± 59.5	0.59
48 h	263.7 ± 104.2	264.3 ± 93.9	0.98
Accumulated number of attempts for IV-PCA bolus			
1 h	10.7 ± 42.3	1.0 ± 1.4	0.231
6 h	37.6 ± 85.9	7.9 ± 11.0	0.075
12 h	41.8 ± 96.6	9.5 ± 14.0	0.086
24 h	46.1 ± 111.2	12.3 ± 15.6	0.116
48 h	49.6 ± 118.3	18.0 ± 24.9	0.169
Accumulated number of actual given IV-PCA boluses			
1 h	1.2 ± 1.0	0.8 ± 0.9	0.099
6 h	6.4 ± 5.0	4.4 ± 3.9	0.102
12 h	8.1 ± 7.1	5.6 ± 5.7	0.151
24 h	9.6 ± 9.6	7.9 ± 7.2	0.447
48 h	11.9 ± 12.4	11.1 ± 10.8	0.782
Nausea or vomiting/dizziness			
0 h	1/1	0/0	1.00/1.00
1 h	1/1	4/0	0.35/1.00
6 h	3/1	3/1	1.00/1.00
12 h	2/0	0/1	0.49/1.00
24 h	0/0	1/0	1.00/–
48 h	1/1	0/0	1.00/1.00

Results are expressed as mean ± SD, median times, number, or number of patients

The RSB group received ultrasound-guided bilateral rectus sheath block (US-BRSB) with 30 ml of 0.25% ropivacaine

RSB rectus sheath block, *PACU* postanesthesia care unit, *IV-PCA* intravenous patient-controlled analgesia

a continuous dose of IV-PCA; however, IV-PCA findings were similar between groups, because the use of a continuous dose did not allow us to assess the intention of patients or the intensity of pain. Furthermore, we used ramosetron hydrochloride, which might play a role in this insignificance. As a result, we observed no significant difference between groups in terms of nausea or vomiting.

Interestingly, excessive attempts at bolus infusion were observed in three patients in the control group, who pressed the bolus button 266 times on average during the first 6 h. Two of these patients were undergoing total laparoscopic hysterectomy, while the third patient was undergoing ovarian cystectomy. Accompanying adhesiolysis was performed in one of the two patients undergoing total laparoscopic hysterectomy. The operation time in these patients ranged from 70 to 90 min, and we observed no excessive bleeding or other remarkable event. Bolus attempts during the initial 6 h represented approximately 86% of all attempts in these patients over the entire 48-h postoperative period. This suggests that the US-BRSB could have played a role in absence of the excessive bolus attempts in the early postoperative period. However, there were no significant differences in the actual given dose of fentanyl injected with PCA bolus at the early postoperative timepoints (Table 3). We thought

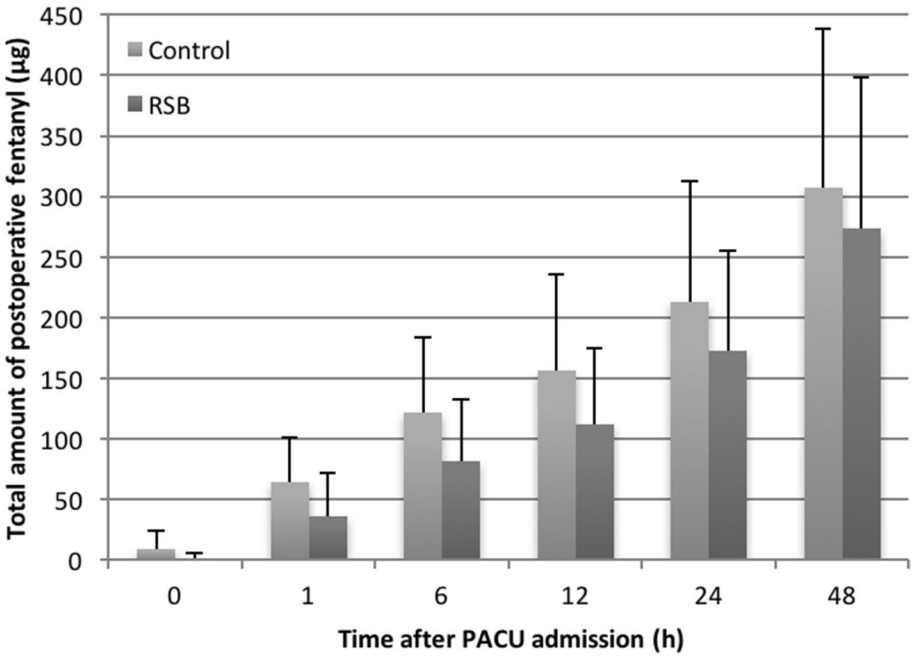

Fig. 2 Total postoperative fentanyl consumption. Data are expressed as mean ± SD. Consumption was decreased in the RSB group relative to the control group, but the difference was not significant ($p > 0.05$). *PACU* postanesthesia care unit, *RSB* rectus sheath block

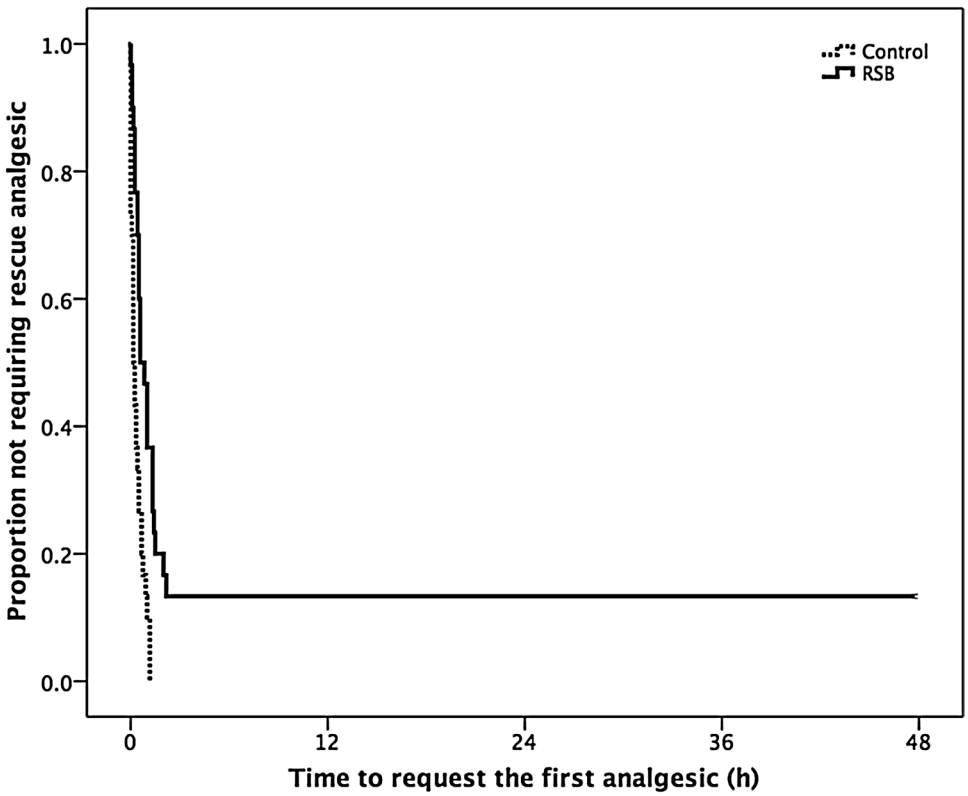

Fig. 3 Kaplan–Meier curve analysis comparing groups. The *X*-axis shows the time for the first rescue analgesic requirement. The *Y*-axis shows proportion of patients who did not require rescue analgesics. The median time to request the first rescue analgesic was prolonged in the RSB group compared to the control group (35 vs. 10 min, respectively; $p < 0.001$). Four patients in the RSB group did not request any rescue analgesics during the 48-h follow-up period. *RSB* rectus sheath block

that it may be because that the IV-PCA has the lock-out time. When the bolus did not meet the patient's requirement due to the lock-out time, the rescue pain medication would have been needed and this made the next bolus injection skipped or delayed. Consequently, there was no difference in the amount of bolus in the PACU, but the total amount of fentanyl was different (Table 3).

This study had several limitations. First, the anesthesiologist who participated that the surgery was not blinded, because we did not perform sham block to the control group.

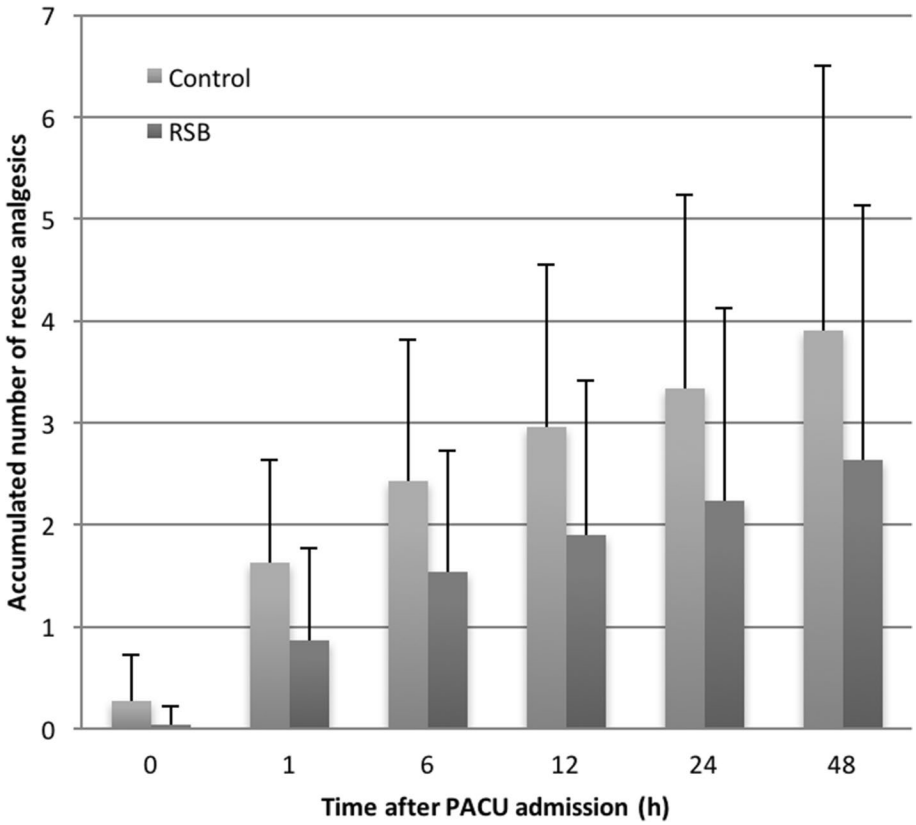

Fig. 4 Cumulative number of rescue analgesics. Data are expressed as mean ± SD. The cumulative number of rescue analgesics was significantly lower in the RSB group compared to the control group at all timepoints ($p < 0.05$). *PACU* postanesthesia care unit, *RSB* rectus sheath block

Knowing that the group assignment might affect intraoperative fentanyl dose, however, in reality, the difference between two groups was not significant. Visceral source of pain, short operation time might affect to this insignificance and might have offset the likelihood of the bias. Second, we did not assess ambulatory outcomes, such as the maximum possible walking distance at each timepoint. However, we suspect that low VNRSc scores would be associated with faster ambulation and recovery. A third limitation was that the VNRS assessment was of global pain; i.e., it was not separated into visceral and somatic pain, because we suspected that it would be difficult for patients to define the origin of their pain. Finally, we obtained no data on patient satisfaction, as indicated by postoperative quality-of-life or recovery assessments. These limitations should be addressed in future studies to validate the scenario that we outline above.

In conclusion, US-BRSB is a safe and easily applicable procedure that confers benefits with respect to reduced pain and opioid consumption in the immediate postoperative period.

Compliance with ethical standards

Conflict of interest The authors report no conflict of interest.

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