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Impact of Preoperative versus Postoperative Rectus Sheath Block on Analgesic Outcomes

Bi Lin, Liang Qi, Xuejiao Liu, Liangrong Wang *

Department of Anesthesiology, the First Affiliated Hospital of Wenzhou Medical University, Wenzhou Zhejiang, 325000, China
*** Corresponding author:** Liangrong Wang

Abstract: Objective This study aimed to determine the optimal timing for administering ultrasound-guided rectus sheath block in patients undergoing laparoscopic colorectal surgery. **Methods** A total of 60 patients who were scheduled to receive laparoscopic radical resection for colorectal cancer were randomly assigned to either Group A or Group B.Group A received the rectus sheath block under ultrasound guidance before surgery, while Group B received the same intervention after surgery.The two groups were compared in terms of Visual Analogue Scale (VAS) scores assessed both at rest and with movement at three time points: 10 minutes after tracheal extubation (T1), 24 hours post-surgery (T2), and 48 hours post-surgery (T3).Recorded parameters also included mean arterial pressure (MAP) and heart rate (HR) measured before and after skin incision. Additional analyses covered intraoperative propofol and remifentanil consumption, the need for rescue analgesia after surgery, perioperative Quality of Recovery-15 (QoR-15) scores, Pittsburgh Sleep Quality Index (PSQI) on postoperative day one, and the occurrence of postoperative nausea and vomiting. **Results** In both groups, VAS scores at rest and during activity recorded at T2 and T3 were significantly lower than those measured at T1 ($P < 0.05$). At T1, Group A showed significantly lower VAS scores than Group B under both resting and active conditions ($P < 0.05$). However, no significant intergroup differences were observed at T2 or T3. Group A also experienced a significantly longer interval before the first request for patient-controlled analgesia, as well as a reduced duration of stay in the post-anesthesia care unit (PACU) and better PSQI scores ($P < 0.001$). Compared with Group B, Group A had significantly reduced intraoperative use of propofol and remifentanil, along with a lower post-incision mean arterial pressure ($P < 0.05$). **Conclusion** Administering ultrasound-guided rectus sheath block prior to surgery offers better early postoperative pain control for patients receiving laparoscopic radical resection of colorectal cancer, decreases the need for intraoperative general anesthetics, and enhances postoperative sleep quality.

Keywords: Rectus Sheath Block; Laparoscopic Colorectal Operation; Postoperative Analgesia.

1. Introduction

Colorectal cancer ranks third in global incidence, and laparoscopic radical resection is a commonly used treatment modality. Although laparoscopic surgery offers advantages over traditional open surgery in terms of reduced trauma and improved safety, a considerable number of patients still experience moderate to severe postoperative pain, which affects the recovery process [1]. Compared with thoracic epidural analgesia—a traditional regional block technique for abdominal surgery—ultrasound-guided rectus sheath nerve block (RSB) is simpler, safer, associated with fewer complications, and easier to manage postoperatively [2]. However, studies on the optimal timing of RSB administration remain limited. This study aims to compare the effects of preoperative versus postoperative RSB on postoperative analgesic outcomes in patients.

2. Materials and Methods

2.1. Inclusion and Exclusion Criteria

A total of 64 individuals who were scheduled to undergo elective laparoscopic radical resection for colorectal cancer at The First Affiliated Hospital of Wenzhou Medical University from December 2024 to April 2025 were recruited and randomly divided into either Group A or Group B. Eligibility requirements included an age range of 50 to 80 years and an American Society of Anesthesiologists (ASA) physical status of II or III. Exclusion criteria comprised severe cardiopulmonary disorders, localized skin lesions or infections, known hypersensitivity to local anesthetics, a history of chronic pain, or previous abdominal surgery. During the study, four patients were excluded because their surgery was converted intraoperatively to a different procedure, leaving a final study population of 60 patients (30 in each group). The study protocol received approval from the hospital's ethics committee (Approval Number: KY2024-306). Written informed consent was secured from each patient or, when applicable, from their legally authorized family members.

2.2. Anesthesia and Postoperative Analgesia Protocol

All patients received a standardized general anesthesia regimen. Both groups received the same anesthesia induction: propofol 2.0 mg/kg, sufentanil 0.3μg/kg, and rocuronium 0.6 mg/kg. Intraoperatively, 1%–1.5% sevoflurane was inhaled to keep the minimum alveolar concentration (MAC) of the inhaled anesthetic at 0.8. Meanwhile, anesthesia depth was maintained with propofol at 4–6 mg/(kg·h) and remifentanil at 0.1–0.2μg/ (kg·min), and the bispectral index (BIS) was adjusted to 45–60.

Postoperatively, all patients were provided with patient-controlled intravenous analgesia (PCIA) using sufentanil at a concentration of 1 μg/mL, with a continuous background infusion of 2 mL/h, a demand bolus of 1 mL, and a lockout interval of 15 minutes. If the resting Visual Analogue Scale (VAS) score reached 4 or higher, or if the patient experienced intolerable incisional pain, rescue analgesia was given as intravenous tramadol at a dose of 1 mg/kg.

Group A underwent RSB after general anesthesia induction and before surgery, while Group B received RSB at surgery completion prior to extubation. Under ultrasound guidance using a Mindray M7 system with an 8–12 MHz linear array probe, the rectus abdominis muscle and its posterior sheath were identified. An in-plane needle insertion technique was employed to advance the needle tip into the potential space located between the rectus abdominis muscle and the posterior rectus sheath. Following negative aspiration to rule out intravascular placement, 20 mL of 0.375% ropivacaine was injected. Successful block was verified by observing hypoechoic fluid distribution along the posterior rectus sheath. The identical procedure was then repeated on the opposite side.

2.3. Clinical Variables

The visual analogue scale (VAS) scores at rest and during activity were recorded at three time points: 10 minutes after extubation (T1), and 24 hours (T2) and 48 hours (T3) postoperatively. Heart rate (HR) and mean arterial pressure (MAP) were documented before and after surgical incision, along with intraoperative propofol and remifentanil consumption. Quality of Recovery-15 (QoR-15) scores, ranging from 0 to 150, were assessed one day preoperatively and on postoperative days 1 and 3; higher scores indicated better recovery quality [3]. The Pittsburgh Sleep Quality Index was recorded on the first postoperative day, with higher scores reflecting poorer sleep quality. Additional recorded indicators included length of stay in the post-anesthesia care unit (PACU), time to first patient-controlled analgesia (PCA) press, number of effective PCA presses within 48 hours, requirement for rescue analgesia, and incidence of adverse reactions such as nausea, vomiting, dizziness, and somnolence. All the above indicators were compared between the two groups.

2.4. Statistical Analysis

Data were statistically analyzed using SPSS 26.0 software. For continuous data with a normal distribution, the independent-samples t-test was used for comparison between two groups, and the paired t-test was used for comparison before and after treatment, with data expressed as mean ± standard deviation; for continuous data that did not follow a normal distribution, intergroup comparisons were conducted using the Mann-Whitney U test, while comparisons across multiple time points were performed using the Friedman test. Pairwise post-hoc comparisons were adjusted using the Dunn-Bonferroni correction, and results were reported as median with interquartile range. Categorical variables were compared using the Chi-square test and expressed as frequencies (percentages). All statistical tests were two-tailed, with a significance threshold set at $P < 0.05$.

3. Results

The two groups showed no significant differences in baseline demographic or operative characteristics (Table 1). There were no statistically significant intergroup differences regarding sex, age, body mass index (BMI), American Society of Anesthesiologists (ASA) physical status, history of comorbid diseases, or surgical duration.

For both groups, Visual Analog Scale (VAS) scores at rest and during movement recorded at T2 and T3 were markedly reduced compared with those measured at T1 ($P<0.05$). At T1, Group A exhibited significantly lower VAS scores under both resting and dynamic conditions than Group B ($P<0.05$). However, no significant intergroup differences were detected at either T2 or T3 ($P>0.05$) (Table 2).

Prior to skin incision, there were no significant intergroup differences in mean arterial pressure (MAP) or heart rate (HR) ($P>0.05$). Following incision, both groups demonstrated a significant increase in MAP and HR relative to pre-incision values ($P<0.05$). Nevertheless, the magnitude of MAP elevation was significantly less pronounced in Group A compared with Group B ($P < 0.05$). Group A required significantly lower intraoperative doses of both propofol and remifentanil than Group B ($P < 0.001$) (Table 3).

The interval from surgery completion to the first patient-controlled analgesia (PCA) pump activation was significantly prolonged in Group A relative to Group B ($P < 0.001$). In contrast, no significant intergroup differences were found in the total number of effective PCA demands or the incidence of rescue analgesia within the first 48 postoperative hours (Table 4).

Table 1. Demographic and clinical characteristics

	Group A(n=30)	Group B(n=30)	t/χ2/Z	P
Gender			2.7	0.1
male	23(76.67)	17(56.67)		
female	7(23.33)	13(43.33)		
Age(years)	67.77 ± 9.46	66.74 ± 9.85	0.414	0.68
BMI (kg/m^2)	23.88 ± 2.27	23.01 ± 2.53	1.415	0.162
ASA			0.185	0.667
II	26(86.67)	28(93.33)		
III	4(13.33)	2(6.67)		
Hypertension	20 (66.7)	23 (76.7)	0.741	0.389
Diabetes mellitus	11 (36.7)	7 (23.3)	1.267	0.260
Coronary heart disease	3 (10.0)	5 (16.7)	0.581	0.446
operative time (min)	156.30 ± 37.73	147.13 ± 38.75	0.936	0.353

Table 2. Postoperative VAS scores in Group A and Group B at all time points

		T1	T2	T3	Z	P
VAS pain score at rest (mm)	Group A	2.25(1.62,3.38)	2.00(1.85,2.58)	2.00(2.00,2.00)	4.351	0.114
	Group B	3.30(2.60,4.25)	2.00(2.00,3.00) *	2.00(1.50,2.00) *#	32.509	<0.001
	Z	-2.967	-1.032	1.233		
	P	0.003	0.302	0.218		
VAS pain score during coughing (mm)	GroupA	5.00(4.00,5.50)	3.70(3.00,4.00) *	3.00(3.00,3.00) *	44.418	<0.001
	GroupB	6.00(5.00,6.25)	3.60(3.00,4.35) *	3.00(3.00,3.30) *	38.643	<0.001
	Z	-2.474	-1.17	-0.669		
	P	0.013	0.242	0.503		

Note: * $P < 0.05$ vs. T1; # $P < 0.05$ vs. T2.

Table 3. Comparison of intraoperative variables between the two groups

	Mean arterial pressure (MAP)		Heart rate (HR)		Propofol (mg)	Remifentanil (ug)
	pre-incision	post-incision	pre-incision	post-incision		
Group A (n=30)	84.83 ± 11.75	91.08 ± 10.18*	64.50 ± 8.34	65.97 ± 8.65*	425.43 ± 103.00	1036.90 ± 184.28
Group B (n=30)	78.32 ± 13.71	100.74 ± 11.92*	61.03 ± 7.76	66.65 ± 10.38*	564.77 ± 117.41	1449.23 ± 264.91
t	1.989	- 3.4	1.682	- 0.277	- 4.921	- 7.076
P	0.051	0.001	0.098	0.783	< 0.001	< 0.001

Table 4. Postoperative rescue analgesia: comparison between the two groups

	Time to first PCA pump press (min)	Effective PCA pump presses within 48 hours (n)	Rescue analgesia within 48 hours [n (%)]
Group A (n=30)	116.6 ± 35.8	4.83 ± 1.12	8(26.67)
Group B(n=30)	38.0(25.0-49.0)*	5.27 ± 0.94	15(48.39)
U/t/χ2	101.5	- 1.667	3.062
P	< 0.001	0.101	0.080

Table 5. Perioperative QoR-15 scores in Group A and Group B at different time points

	Preop 1 d	POD 1	POD 3
Group A (n=30)	130.63±3.14	99.07±3.82*	113.70±4.26*
Group B (n=30)	130.37±3.37	97.93±4.21*	114.37±4.07*
t	0.324	1.102	-0.642
P	0.747	0.275	0.523

Note: * $P < 0.05$ vs. preoperative day 1

Table 6. Postoperative status in Group A and Group B

	Nausea/vomiting [n (%)]	Dizziness [n (%)]	Somnolence [n(%)]	PSQI scores	PACU stay time (min)
Group A (n=30)	4(13.33)	5(16.67)	5(16.67)	5.87 ± 1.14	59.77 ± 11.02
Group B (n=30)	5(16.7)	4 (13.33)	3(10.0)	7.27 ± 1.20	74.60 ± 18.22
χ2/t	0.135	0.143	0.581	- 4.693	- 4.017
P	0.714	0.705	0.446	< 0.001	< 0.001

The Pittsburgh Sleep Quality Index (PSQI) score on the first postoperative day was significantly lower in Group A than in Group B ($P < 0.001$, indicating better sleep quality. Quality of Recovery-15 (QoR-15) scores decreased significantly after surgery compared with preoperative values in both groups ($P < 0.05$), with no significant intergroup differences. No significant differences were observed in the incidence of postoperative nausea and vomiting, dizziness, or somnolence between the two groups ($P > 0.05$) (Tables 5 and 6).

4. Discussion

Inadequate management of early postoperative pain not only limits effective patient mobilization, delays the time to first ambulation, increases the risk of pulmonary complications and lower extremity venous thromboembolism, but also elevates the incidence of chronic pain and induces anxiety and depression. Therefore, optimizing postoperative pain management plays a crucial role in postoperative

rehabilitation [4, 5]. Studies have shown [5] that among patients undergoing abdominal surgery, 37.3% experienced moderate pain and 35.7% suffered from severe pain at 8 hours postoperatively, while 92.1% of patients reported limited physical activity due to pain. A survey by Terrie Vasilopoulos [6] demonstrated that the mean pain intensity on the first postoperative day was moderate in patients with colorectal cancer, highlighting the urgency of postoperative analgesia. As a regional analgesic technique, bilateral rectus sheath block (RSB) has been proven applicable to midline incision surgeries including gastric, pancreatic, rectal and gynecological procedures. It can enhance pain control within 12 hours after laparoscopic surgery and reduce opioid consumption [7-9].

In the present study, VAS scores at T2 and T3 were lower than those recorded at T1 in both groups, indicating adequate analgesic efficacy. These findings further support the conclusion that rectus sheath block constitutes a reliable and effective analgesic modality for individuals undergoing laparoscopic radical resection of colorectal cancer. These results align broadly with the observations of Chai Bin [10], who reported that the combination of ultrasound-guided serratus anterior plane block and rectus sheath block yielded analgesic effects lasting up to 24 hours. In a study by Kuniyoshi [11], continuous rectus sheath block was compared with continuous epidural analgesia for postoperative pain control in patients undergoing gynecologic cancer surgery. The findings indicated that rectus sheath block was non-inferior to epidural analgesia with respect to resting pain relief, while providing benefits in terms of procedural simplicity and enhanced safety, thereby serving as a suitable alternative when epidural analgesia is difficult to perform. Most patients with colorectal cancer enrolled in this study were elderly and frequently presented with comorbid cardiovascular or cerebrovascular conditions. In some cases, epidural puncture was either contraindicated or technically challenging due to prolonged anticoagulant therapy or calcification of the spinal ligaments. Accordingly, the use of rectus sheath block in laparoscopic radical resection of colorectal cancer demonstrates considerable promise for clinical application.

Comprehensive goal-directed perioperative analgesia (CGPA) is an important component of enhanced recovery after surgery (ERAS) [12]. Preemptive analgesia, which involves administering analgesic interventions before the onset of hyperalgesia to prevent central and peripheral sensitization, is a key element of CGPA [13]. Analgesic intervention administered before surgical incision has been clearly shown to prevent hyperalgesia and improve postoperative analgesic efficacy [14]. Mario Nosotti [14] demonstrated that preoperative intercostal nerve block provided preemptive analgesic effects and reduced early postoperative analgesic administration compared with placebo and/or postoperative intercostal nerve block. Mayuko[15] conducted a retrospective cohort study and found that in laparoscopic surgery, preoperative rectus sheath block (RSB) prolonged the time to first rescue analgesia and reduced the frequency of analgesic use within the first 24 hours postoperatively compared with postoperative RSB. Yagi [16] reported that the proportion of patients receiving nonsteroidal anti-inflammatory drugs was significantly lower in those who received preoperative transversus abdominis plane block combined with rectus sheath block compared with those who received the block within the first 12 hours after surgery. The results of this study showed that patients in Group A (preoperative RSB) had lower VAS scores at rest and during movement at T1 (immediately after extubation) compared with Group B. Resting VAS scores remained at low levels across all time points, the time to first PCA pump press was significantly prolonged, and the length of stay in the post-anesthesia care unit (PACU) was significantly shortened. These findings indicate that preoperative RSB provides sustained and stable resting analgesia from the early recovery period through the extended postoperative period, further validating the advantages of preoperative nerve block in providing preemptive analgesia. A recent domestic study also found that preoperative rectus sheath block provided superior early analgesic effects in patients undergoing laparoscopic gynecologic surgery, which is generally consistent with the findings of this study [17].

Various stimuli during surgery can increase the activity of the sympathetic–adrenal medullary system and enhance the secretion of adrenal medullary hormones, leading to elevated blood pressure and increased heart rate. General anesthesia alone cannot completely block the disruptive stimuli caused by surgical manipulation. Early application of RSB can effectively inhibit regional neuronal excitability, reduce intraoperative stress responses, stabilize cardiovascular function, and maintain hemodynamic stability. Previous studies have shown that RSB provides better analgesia and greater hemodynamic stability in patients undergoing gastrectomy [18] and reduces intraoperative and postoperative opioid consumption in patients undergoing abdominal surgery [19]. This study showed that compared with Group B, patients in Group A exhibited smaller changes in mean arterial pressure before and after skin incision, as well as significantly reduced intraoperative remifentanil and propofol consumption. These findings suggest that RSB combined with general anesthesia, through effective local anesthetic analgesia, can alleviate perioperative stress responses, reduce the dosage of general anesthetics, and facilitate early recovery.

Postoperative sleep disturbances frequently occur following general anesthesia and are influenced by a variety of factors, among which postoperative pain is regarded as a primary contributor [20]. A bidirectional, self-perpetuating relationship exists between pain and sleep disruption: pain impairs sleep quality, while insufficient sleep heightens pain sensitivity, thereby increasing the risk of postoperative delirium, cognitive impairment, and depression—ultimately delaying recovery [21, 22].In a study by Wang Yuxiu [23], the application of ultrasound-guided bilateral quadratus lumborum block in laparoscopic colorectal surgery was shown to reduce pain and enhance patients' sleep quality. In the current study, patients in Group A exhibited significantly lower Pittsburgh Sleep Quality Index (PSQI) scores on the first postoperative day compared with those in Group B, providing direct evidence that early analgesia contributes to improved sleep outcomes. The Quality of Recovery-15 (QoR-15) serves as a validated instrument for assessing early postoperative recovery quality [3]. Although QoR-15 scores declined markedly in both groups after surgery, they improved by postoperative days 1 and 3, with no significant intergroup differences, indicating comparable recovery profiles between the two groups.

5. Conclusion

In summary, preoperative ultrasound-guided rectus sheath

nerve block offers better early postoperative analgesia in patients undergoing laparoscopic radical resection of colorectal cancer, reduces intraoperative anesthetic requirements, and improves sleep quality, thereby holding significant value for clinical application.

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