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The effect of continuous intravenous lidocaine infusion on postoperative analgesia in elderly patients undergoing laparoscopic colorectal surgery

Qing Wan[1], Qianglin Yi[2], Ruwen Huang[1], Nian Wang[1] and Qingfan Zeng[3*]

Abstract

Background This study aimed to evaluate the effect of continuous intravenous infusion of different doses of lidocaine on postoperative analgesia in elderly patients undergoing laparoscopic colorectal surgery.

Methods In this prospective, randomized, double-blind pilot study, elderly patients undergoing laparoscopic colorectal surgery at the Affiliated Cancer Hospital of Guizhou Medical University between January 2024 and February 2025 were enrolled. All patients received anterior quadratus lumborum block under ultrasound guidance combined with general anesthesia. Participants were randomized into three groups based on the lidocaine infusion dose after tracheal intubation: Group L (1.0 mg/kg/h), Group M (1.5 mg/kg/h), and Group H (2.0 mg/kg/h). The primary outcome was postoperative pain intensity assessed by the Numeric Rating Scale (NRS) at predefined time points. Secondary outcomes included patient-controlled analgesia (PCA) usage, postoperative opioid consumption, requirement of intraoperative ephedrine, Modified Observer's Assessment of Alertness/Sedation (MOAA/S) scores, and incidence of postoperative adverse events.

Results A total of 114 patients aged ≥ 65 years (52 males and 62 females) were included with 38 cases in each group. Baseline demographic and clinical characteristics were comparable among the three groups. There were significant differences in postoperative pain NRS scores at 12-hour and 24-hour among three groups (both $P < 0.001$). Compared with the L group, the postoperative 12-hour and 24-hour pain NRS scores were significantly lower in both the M and H groups ($P < 0.05$) Compared to Group L, both Group M and Group H demonstrated significantly reduced cumulative PCA usage and postoperative opioid consumption ($P < 0.05$). Group H showed a higher requirement for intraoperative ephedrine compared to Groups L and M ($P < 0.05$). Upon entry into the post-anesthesia care unit, Groups L and M had significantly higher MOAA/S scores than Group H ($P < 0.05$). No significant differences were found in the incidence of adverse events among three groups ($P > 0.05$).

Conclusion In elderly patients undergoing laparoscopic colorectal surgery, continuous intravenous lidocaine infusion at 2.0 mg/kg/h significantly reduced postoperative pain intensity at 12 and 24 h compared with 1.0 mg/

*Correspondence:
Qingfan Zeng
445483296@qq.com

Full list of author information is available at the end of the article

kg/h. Based on these findings, the effective dosage range appears to be 1.5–2.0 mg/kg/h. Further studies with larger sample sizes are needed to confirm these results.

Clinical trial number ChiCTR2500097315 (Retrospectively registered).

Keywords Lidocaine, Colorectal surgery, Quadratus lumborum block, Elderly patients

Background

Colorectal cancer ranks as the third most common malignancy worldwide and is the second leading cause of cancer-related deaths [1]. Patients aged over 75 years remain a high-risk population for colorectal cancer [2]. Surgical treatment continues to be the cornerstone for colorectal cancer management, and studies have reported that the five-year survival rate for early-stage colorectal cancer patients undergoing surgical treatment exceeds 90% [3–5]. However, stress responses induced by surgery and postoperative pain can lead to adverse outcomes, including gastrointestinal dysfunction [6]. Recent studies have reported that continuous intravenous infusion of lidocaine during the perioperative period can alleviate postoperative pain and accelerate recovery in adults [7], suggesting that intravenous lidocaine may be incorporated into multimodal analgesia and early postoperative rehabilitation protocols.

Lidocaine, a widely utilized local anesthetic belonging to the amino amide class, exerts its pharmacological effects through the blockade of voltage-gated sodium channels, thereby preventing both the initiation and conduction of action potentials in nerve fibers, which may be specific to the type of pain being treated [8]. Intravenous lidocaine administration has been associated with extended pain relief, anti-inflammatory effects, and hastened recovery of gastrointestinal function [7]. Thus, the latest ERAS guidelines for colorectal surgery strongly recommend multimodal analgesic techniques, including intravenous lidocaine, to minimise opioids [9]. Despite the fact that a typical maintenance infusion rate is 1.5 mg/kg/h [10], its blood concentrations have been sometimes below toxic concentrations (>5 μg/mL) in clinical studies [11]. Notably, a continuous intravenous infusion of lidocaine-assisted aesthesia with 2 mg/kg/h has not resulted in any clinical side effects [12]. Thus, dosing strategies for perioperative lidocaine administration should be evaluated for both better efficacy and safety. Intravenous lidocaine also exerts different impacts on opioid use across age groups [13–15], particularly among elderly patients, for whom the optimal dose plan remains unclear.

This study aims to investigate the effects of intraoperative continuous intravenous infusion of different doses of lidocaine on postoperative analgesia and the incidence of related adverse events in elderly patients undergoing laparoscopic colorectal surgery.

Materials and methods

Study population

This study was approved by the Ethics Committee of the Affiliated Cancer Hospital of Guizhou Medical University (Approval No. FZ2023-06–210), and informed consent was obtained from all patients or their legal guardians prior to anesthesia. Patients scheduled to undergo laparoscopic radical colorectal cancer surgery under ultrasound-guided quadratus lumborum block combined with general anesthesia between January 2024 and February 2025 were enrolled. Inclusion criteria were: aged ≥ 65 years, ASA physical status II–III, and body mass index (BMI) between 18.5 and 27 kg/m². Exclusion criteria included a history of allergy to lidocaine, long-term use of analgesic medications, uncontrolled hypertension (systolic blood pressure ≥ 180 mmHg or diastolic blood pressure ≥ 110 mmHg), severe arrhythmias, severe pulmonary disease, hepatic or renal dysfunction, uncontrolled diabetes mellitus (fasting blood glucose > 10 mmol/L), inability to complete the pain numerical rating scale (NRS) assessment, surgical duration of less than 2 h or more than 5 h, intraoperative blood loss exceeding 800 mL, or postoperative admission to the intensive care unit (ICU). This study was registered with the China Clinical Trial Registry (http://www.chictr.org.cn) prior to patient enrollment (ChiCTR2500097315; Registration Date: [17 February 2025]). This study adhered to the ethical principles outlined in the Declaration of Helsinki and the Consolidated Standards of Reporting Trials (CONSORT) 2010 guidelines.

Grouping and treatment

Patients were randomly assigned to three groups using a random number table: the low-dose group (L group), the medium-dose group (M group), and the high-dose group (H group). A randomized double-blind design was employed; neither the patients nor the postoperative pain assessors were aware of the group allocations. Lidocaine at different doses was prepared by another anesthesiologist, labeled with randomized codes (L, M, or H). The random number table was computer-generated, with a random starting point selected, and numbers read sequentially from left to right. Each participant was assigned to a group based on the remainder of their random number divided by three: those with a remainder of 0 were assigned to the L group, a remainder of 1 to the M group, and a remainder of 2 to the H group. Grouping

information was sealed in opaque envelopes or stored in an electronic system.

All three groups received ultrasound-guided anterior quadratus lumborum block with 60 mL of 0.25% ropivacaine (30 mL per side) performed by the same anesthesiologist. Following induction of general anesthesia and successful endotracheal intubation, continuous intravenous infusion of lidocaine was initiated according to group allocation [Batch number: 20240720, Hubei Tiansheng Pharmaceutical Co., Ltd.]. Patients in the L group received lidocaine at a rate of 1 mg/kg/h until the end of surgery. The infusion rates for the M and H groups were 1.5 mg/kg/h and 2 mg/kg/h, respectively [16], with all other intraoperative management identical to that of the L group.

Anesthesia protocol description

Patients fasted for 8 h and abstained from drinking fluids for 2 h preoperatively. Upon admission to the operating room, a warming blanket was placed on the bed and adjusted to a temperature of 33 °C. Standard monitoring procedures were implemented, and intravenous access was established.

General anesthesia was induced with sufentanil 0.3 μg/kg, propofol 1.5–2 mg/kg, and rocuronium bromide 0.6 mg/kg. Following successful endotracheal intubation, patients were connected to a mechanical ventilator with the following settings: tidal volume 6–8 mL/kg, respiratory rate 12–14 breaths/min, inspiratory-to-expiratory ratio 1:2, inspired oxygen concentration 100%, and oxygen flow rate 2 L/min. End-tidal carbon dioxide ($ETCO_2$) was maintained between 35 and 45 mmHg throughout surgery. Anesthesia maintenance included target-controlled infusion (TCI) of remifentanil at 1.0–3.0 ng/mL and inhalational sevoflurane to maintain a minimum alveolar concentration (MAC) of 0.8–1.0. Rocuronium bromide 0.3 mg/kg was administered intermittently as needed. Intraoperative fluid management was standardized across all patients. The total fluid volume administered was determined by integrating the following components: (1) Maintenance fluid requirements were calculated according to the Holliday-Segar formula (4 mL/kg/h for the first 10 kg, 2 mL/kg/h for the next 10 kg, and 1 mL/kg/h for each additional kg); (2) The preoperative fasting deficit was estimated as the maintenance rate multiplied by the hours of fasting; (3) Ongoing losses, such as blood loss and urinary output, were replaced milliliter-for-milliliter using crystalloid or colloid solutions as clinically indicated; (4) Third-space insensible losses were estimated at 4–6 mL/kg/h based on the extent of surgical trauma. The initial fluid deficit was fully replaced within the first hour of surgery. Subsequently, a continuous infusion was maintained to cover ongoing maintenance requirements, losses, and third-space sequestration. All fluid administration was guided by continuous hemodynamic monitoring, including arterial pressure and heart rate. The protocol permitted clinician-directed adjustments in response to significant hemodynamic variations.

During both induction and maintenance of anesthesia, HR and mean arterial pressure (MAP) fluctuations were controlled within 20% of baseline values. If necessary, ephedrine, atropine, nicardipine, or esmolol was administered to maintain hemodynamic stability. The target-controlled infusion (TCI) of remifentanil was dynamically titrated according to the patient's hemodynamic response to surgical stimuli. The goal was to maintain HR and MAP within ± 20% of pre-induction baseline values. The titration protocol was as follows: if HR or MAP exceeded 120% of baseline, suggesting potential insufficient analgesia or anesthetic depth, the remifentanil TCI target concentration was increased within the predefined range (1.0–3.0 ng/mL). Conversely, if HR or MAP fell below 80% of baseline, indicating possible excessive depth or vasodilation, the target concentration was reduced. A stable volatile anesthetic background was maintained using sevoflurane at an end-tidal concentration of 0.8–1.0 MAC to ensure hypnosis and amnesia. Remifentanil adjustments were made complementarily to this baseline to specifically modulate nociceptive responses reflected in hemodynamic changes. In cases where hemodynamic parameters persistently deviated beyond the ± 20% threshold despite optimization of remifentanil and sevoflurane, adjuvant agents were administered as needed: ephedrine for hypotension, nicardipine or esmolol for hypertension or tachycardia, and atropine for significant bradycardia.

Nasopharyngeal temperature was measured, and the warming blanket was adjusted to maintain the nasopharyngeal temperature between 36 and 37 °C. Approximately 30 min before the end of surgery, additional sufentanil 10 μg and tropisetron 4 mg were administered. At the end of surgery, remifentanil infusion was discontinued, the sevoflurane MAC was reduced to 0.3, and the lidocaine infusion was stopped. Extubation was performed once the patient exhibited signs of awakening, including eye opening, clear consciousness, recovery of cough reflex, and restoration of adequate tidal volume, after which the patient was transferred to the post-anesthesia care unit (PACU) for observation.

All patients received postoperative intravenous patient-controlled analgesia (PCIA). The PCIA formulation consisted of sufentanil 100 μg, nalbuphine 60 mg, tropisetron 6 mg, and dexamethasone 10 mg, diluted with normal saline to a total volume of 150 mL. The initial bolus was 3 mL, with a continuous infusion rate of 2.5 mL/h, a patient-controlled bolus dose of 1.5 mL, and a lockout interval of 15 min. When postoperative pain scores

exceeded 4 on the NRS scale, an intramuscular injection of diclofenac sodium lidocaine 2 mL was administered.

Outcomes

The primary outcome was the postoperative pain intensity, assessed using the NRS (NRS; 0 = no pain, 1–3 = mild, 4–6 = moderate, 7–10 = severe) at the following time points: upon admission to the post-anesthesia care unit (PACU), at PACU discharge, and at 12, 24, 48, and 72 h after surgery.

The secondary outcomes included: (1) The number of patient-controlled analgesia (PCA) presses recorded at 12, 24, and 48 h postoperatively; (2) Total postoperative opioid consumption. (3) Requirement of intraoperative vasopressors (ephedrine dosage). (4) Modified Observer's Assessment of Alertness/Sedation (MOAA/S) scores upon PACU admission; (5) Incidence of postoperative adverse events including nausea, vomiting, tachycardia, hypertension, bradycardia, hypotension, and pruritus, within 48 h.

Sample size calculation

Preliminary experiments indicated that postoperative pain NRS scores did not follow a normal distribution; therefore, a nonparametric method was used for sample size calculation. Using PASS software with the sample size calculation module associated with the Kruskal-Wallis test, the power was set at 0.8 (Power = 0.8) and the significance level at $\alpha = 0.05$. In the pilot study, 27 patients (9 per group) were enrolled. Shapiro-Wilk tests confirmed that postoperative resting NRS scores at 24 h were not normally distributed. The median (Q1, Q3) for each group were as follows: Low-dose group (L group): 4 (3, 5); Medium-dose group (M group): 3 (2, 4); High-dose group (H group): 2 (1, 3).

Based on preliminary experimental data, the intergroup rank-sum differences were calculated and converted into an effect size indicator, yielding a value of 0.3. Using PASS software, and considering a potential patient dropout rate of 20%, the final calculated total sample size required for this study was 75 cases, with approximately 25 cases allocated to each group. During actual enrollment, to account for the complexity of perioperative variables and to ensure the feasibility of subgroup analyses, 38 patients were ultimately included in each group, resulting in a total sample size of 114 cases. Through strengthened follow-up management during the study period, the dropout rate was controlled to below 5%. The final number of cases completed was as follows: 38 cases in the L group, 38 cases in the M group, and 38 cases in the H group.

Table 1 Comparison of patients' general information

Variables	L Group ($n=38$)	M Group ($n=38$)	H Group ($n=38$)	*P* value
Age (years)	75 ± 5.4	74 ± 5.1	76 ± 5.2	0.265
BMI (kg/m^2)	22.53 ± 2.37	22.97 ± 2.22	23.28 ± 2.59	0.389
ASA Classification Ⅱ/Ⅲ	21/17	24/14	20/18	0.630
Surgery time (hours)	3.55 ± 0.77	3.55 ± 0.72	3.53 ± 0.88	0.974
Anesthesia time (hours)	4.44 ± 0.75	4.56 ± 0.79	4.44 ± 0.77	0.857
Awakening time (min)	9.95 ± 2.83	9.26 ± 2.71	10.04 ± 2.76	0.485
Extubation time (min)	10.35 ± 2.93	9.61 ± 2.82	10.44 ± 2.85	0.364

Data are presented as mean ± standard deviation or n

BMI body mass index, *ASA* American Society of Anesthesiologists

Statistical analysis

Data were analyzed using SPSS 20.0 statistical software. Compliance with normal distribution was examined using the Shapiro-Wilk Test. Categorical data are presented as frequence, and quantitative data as mean ± standard deviation or median (Q1,Q3). One-way analysis of variance (ANOVA) with Bonferroni correction was used to compare normally distributed quantitative data among three groups, while the Kruskal Wallis test with Dunn's correction was used to compare the non-normally distributed data. The chi-square test was used for the comparison of categorical variables among groups. Additionally, repeated-measures ANOVA with post hoc Bonferroni test was employed to compare more than two groups, with group as the between-subject factor and time point as the within-subject factor. $P < 0.05$ was considered the level of significance.

Results

Clinical characteristics

A total of 114 patients were enrolled in this study, with 38 patients in each of the L, M, and H groups. The mean age of the participants was 75 years, with a range of 65 to 84 years. There were no statistically significant differences in demographic data and clinical characteristics at baseline among the three groups in terms of age, BMI, ASA classification, duration of surgery and anesthesia, awakening time, or extubation time (Table 1).

Primary outcome

There were significant differences in postoperative pain NRS scores at 12-hour and 24-hour among the three groups (both $P < 0.001$). Compared with the L group, the postoperative 12-hour and 24-hour pain NRS scores were significantly lower in both the M and H groups ($P < 0.05$) (Table 2).

Secondary outcomes

There were significant differences in remifentanil ($P < 0.001$) and ephedrine ($P < 0.001$) consumption among

Table 2 Comparison of postoperative pain NRS scores at different time points

Time points	L Group (*n* = 38)	M Group (*n* = 38)	H Group (*n* = 38)	*P* value
Admission to PACU	1 (0,2)	1 (0,2)	1 (0,2)	0.523
Discharge from PACU	1 (1,2)	1 (1,2)	1 (1,2)	0.518
12 h postoperative	3 (3,4)	2 (1,2)*	2 (1,2)*	**< 0.001**
24 h postoperative	4 (3,4.25)	3 (2,3)*	2.5 (2,3)*	**< 0.001**
48 h postoperative	2 (1.75,3)	2 (1,3)	2 (1,3)	0.852
72 h postoperative	2 (1,3)	2 (1,3)	2 (1.75,3)	0.708

Data are presented as median (Q1, Q3)

NRS Numeric Rating Scales, *PACU* post-anesthesia care unit

*$P < 0.05$ compared with group L

#$P < 0.05$ compared with group M

Table 3 Comparison of intraoperative drug dosages

Drugs	L Group (*n* = 38)	M Group (*n* = 38)	H Group (*n* = 38)	*P* value
Sufentanil (μg)	27.16 ± 1.59	27.79 ± 1.61	27.87 ± 1.88	0.140
Remifentanil (mg)	1.03 ± 0.09	0.92 ± 0.08*	0.90 ± 0.10*	< 0.001
Propofol (mg)	108.43 ± 9.35	113.10 ± 9.39	110.75 ± 11.68	0.141
Ephedrine (mg)	12.39 ± 2.97	13.97 ± 3.14	18.08 ± 2.92*#	< 0.001
Rocuronium Bromide (mg)	64.84 ± 5.58	65.16 ± 5.47	65.87 ± 6.91	0.749

Data are presented as mean ± standard deviation

*$P < 0.05$ compared with group L

#$P < 0.05$ compared with group M

three groups. Compared with the L group, remifentanil consumption was significantly reduced in both the M and H groups ($P < 0.05$). Compared with both the M and L groups, the use of ephedrine was significantly reduced in the H group ($P < 0.05$). There were no statistically significant differences among the three groups in intraoperative consumption of sufentanil, propofol, or rocuronium bromide (Table 3).

The cumulative number of PCA presses and the number of additional analgesic administrations were also significantly lower in the M and H groups than in the L group ($P < 0.05$) (Table 4). In terms of MOAA/S scores, significant differences were observed among three groups ($P < 0.001$). Specifically, the L and M groups had significantly higher scores compared with the H group ($P < 0.05$) (Table 5). No statistically significant differences were observed among the three groups in the incidence of postoperative adverse events within 48 h, including nausea, vomiting, tachycardia, hypertension, bradycardia, hypotension, and pruritus.

Table 5 Comparison of postoperative MOAA/S scores

Scores	L Group (*n* = 38)	M Group (*n* = 38)	H Group (*n* = 38)	*P* value
MOAA/S	4 (4,5)	4 (3,5)	2 (1,3)*#	**< 0.001**

Data are presented as median (Q1, Q3)

MOAA/S Modified Observer's Assessment of Alertness/Sedation scale

*$P < 0.05$ compared with group L

#$P < 0\ 0.05$ compared with group M

Discussion

In elderly patients undergoing laparoscopic colorectal surgery, continuous intravenous lidocaine infusion at 2.0 mg/kg/h significantly reduced postoperative pain intensity at both 12 and 24 h compared with 1.0 mg/kg/h. These findings suggest that an effective dosage range lies between 1.5 and 2.0 mg/kg/h. Further large-scale studies are warranted to validate the optimal dose and confirm its clinical applicability.

Generally, a common lidocaine approach involves a 1–2 mg/kg loading dose and a 1–2 mg/kg/h maintenance infusion. This strategy maintains therapeutic concentrations (0.5–5 μg/mL) and improves postoperative pain control [17]. Thus, our study selected the three doses, including 1.0, 1.5 and 2.0 mg/kg/h. The L group (1.0 mg/kg/h) failed to significantly reduce intraoperative opioid consumption and exhibited relatively poorer postoperative analgesia due to the short half-life and low blood drug concentration of lidocaine [18]. Evidence suggests that lidocaine doses of 1.33–3 mg/kg/h, adjusted for weight, produce target plasma concentrations of 2–5 μg/mL [19]. High-dose intravenous infusion of lidocaine in this study provided better postoperative analgesic effects

Table 4 Comparison of cumulative PCA press counts and cumulative analgesic use at different time points

Variables	Time points after operation	L Group (*n* = 38)	M Group (*n* = 38)	H Group (*n* = 38)	*P* value	L vs. M *P* value	L vs. H *P* value	M vs. H *P* value
Cumulative PCA press counts	12 h	4 (2,6)	2 (2,4)*	3 (2,4)*	**0.013**	**0.023**	**0.046**	1.000
	24 h	4.5 (3,7)	3 (3,4)*	3.5 (3,4)*	**0.011**	**0.019**	**0.039**	1.000
	48 h	5 (2,7)	3 (3,4)*	3 (3,4)*	**0.015**	**0.049**	**0.026**	1.000
Cumulative analgesic use	12 h	3 (3,4)	2 (2,3)*	2 (2,3)*	**< 0.001**	**< 0.001**	**< 0.001**	1.000
	24 h	4 (4,5)	3 (3,4)*	3.5 (3,4)*	**< 0.001**	**< 0.001**	**< 0.001**	1.000
	48 h	4 (4,6)	3 (3,4)*	4 (3,4)*	**< 0.001**	**< 0.001**	**< 0.001**	1.000

Data are presented as median (Q1, Q3)

PCA patient-controlled analgesia

*$P < 0.05$ compared with group L

with comparable intraoperative opioid consumption and postoperative pain NRS scores in the M and H groups. Due to physiological changes such as attenuated vasoconstriction and less subcutaneous fat, elderly individuals absorb local anesthetics more rapidly, necessitating strict adherence to reduced dosing thresholds [20]. Notably, the international consensus on intravenous lidocaine for postoperative pain also recommended an infusion of no more than 1.5 mg/kg/h for no longer than 24 h [21]. These findings suggest that 1.5 mg/kg/h is sufficient to achieve satisfactory analgesia in elderly patients, which was consistent with previous studies on elderly patients undergoing hip fracture surgery [22].

Previous studies have examined combined intravenous lidocaine and opioids for sedation during colonoscopy or surgery [23, 24], but hemodynamic effects, particularly in elderly patients, remain poorly documented. Our study investigated lidocaine's opioid-sparing effect while monitoring hemodynamic responses. Our results showed no significant differences in MAP and HR among groups at time point. Similarly, a previous study showed that a lidocaine-based regimen for induction of anesthesia reduced the risk of postinduction hypotension in older patients [25] and maintained the HR in arrhythmias and heart failure patients [26].

As a local anesthetic, lidocaine can cause toxic reactions such as dizziness, drowsiness, and perioral numbness when used improperly. Considering that the study subjects were elderly patients, the infusion dose selected in this study was lower than that reported in most previous studies with 2–3 mg/kg/h of intravenous lidocaine [27]. A meta-analysis has indicated that although intravenous lidocaine may increase the risk of side effects, the risk of serious adverse events is negligible [28]. In the present study, no lidocaine toxicity-related adverse events were observed in any of the three groups, confirming that the dosing range used is safe for elderly patients. Importantly, lidocaine toxicity can result from drug accumulation or its active metabolites, making patients with hepatic or renal dysfunction particularly susceptible [29]. Thus, simultaneous monitoring of the plasma concentrations of lidocaine and its active metabolites is recommended in patients who are at high risk of adverse events [30].

Although intravenous injection of lidocaine can alleviate postoperative pain, its underlying mechanisms have not been fully elucidated. Potential mechanisms may involve blockade of Na^+ channels, inhibition of N-methyl-D-aspartic acid (NMDA) receptors, stabilization of cell membranes, regulation of cytokines, and suppression of excessive inflammatory responses [31, 32]. This study did not include the measurement of relevant biomarkers. Previous studies have reported that for quadratus lumborum block, local anesthetics such as ropivacaine can be selected at concentrations ranging from 0.2% to 0.5%, with dosage adjustments made as needed to ensure that the toxic threshold is not exceeded [33]. In the present study, both ropivacaine and lidocaine were used. Although no local anesthetic toxicity-related adverse reactions were observed postoperatively, plasma concentrations of the local anesthetics were not measured, and further research is required.

Limitations

This study has several limitations. First, it was conducted at a single center, which may limit the generalizability of the findings. Second, the follow-up duration was limited to 72 h postoperatively, which may not capture longer-term analgesic effects or complications. Lastly, patient-reported outcomes such as pain perception are inherently subjective and may be influenced by individual psychological factors.

Conclusion

In elderly patients undergoing laparoscopic colorectal surgery, continuous intravenous lidocaine infusion at 2.0 mg/kg/h significantly reduced postoperative pain scores at 12 and 24 h compared with 1.0 mg/kg/h. These results suggest that an effective dosage range lies between 1.5 and 2.0 mg/kg/h. Further large-scale studies are warranted to confirm the optimal regimen and its clinical applicability.

Abbreviations

NRS	Numeric Rating Scale
PCA	Patient–Controlled Analgesia
MOAA/S	Modified Observer's Assessment of Alertness/Sedation
PACU	Post–Anesthesia Care Unit
ASA	American Society of Anesthesiologists
BMI	Body Mass Index
MAP	Mean Arterial Pressure
HR	Heart Rate
ERAS	Enhanced Recovery After Surgery
ICU	Intensive Care Unit
NMDA	N–Methyl–D–Aspartate
$ETCO_2$	End–Tidal Carbon Dioxide
MAC	Minimum Alveolar Concentration
TCI	Target–Controlled Infusion
I FEED	Intake, Feeling nauseated, Emesis, Physical Exam, Duration of symptoms

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Authors' contributions

Wan Qing and Zeng Qingfan carried out the studies, participated in collecting data, and drafted the manuscript. Yi Qianglin and Wan Qing performed the statistical analysis and participated in its design. Huang Ruwen and Wang Nian participated in acquisition, analysis, or interpretation of data and draft the manuscript. All authors read and approved the final manuscript.

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Data availability
All data generated or analysed during this study are included in this published article.

Declarations

Ethics approval and consent to participate
All procedures were performed in accordance with the ethical standards laid down in the 1964 Declaration of Helsinki and its later amendments. This study was approved by the Ethics Committee of the Affiliated Cancer Hospital of Guizhou Medical University (Approval No. FZ2023-06-210), and written informed consent was obtained from all patients or their legal guardians prior to anesthesia. The study was carried out in accordance with the applicable guidelines and regulations.
This study was registered with China Clinical Trial Registry (http://www.chictr.org.cn) prior to patient enrollment (ChiCTR2500097315; Registration Date: [17 February 2025]). This study adhered to the ethical principles outlined in the Declaration of Helsinki and the Consolidated Standards of Reporting Trials (CONSORT) 2010 guidelines.

Consent for publication
Not Applicable.

Competing interests
The authors declare no competing interests.

Author details
[1]Department of Anesthesiology, The Affiliated Cancer Hospital of Guizhou Medical University, Guizhou 550000, China
[2]Department of Anesthesiology, Guiyang Fourth People's Hospital, Guiyang, Guizhou 550002, China
[3]Department of Anesthesiology, The Affiliated Baiyun Hospital of Guizhou Medical University, Guizhou 550000, China

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