The effect of perioperative intravenous lidocaine infusion on postoperative sleep of elderly patients with colorectal cancer

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Research Article

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Abstract

Background: Postoperative sleep disturbance (POSD) in patients with colorectal cancer is a key factor affecting their rapid postoperative recovery. Studies have confirmed that perioperative use of opioids can disturb postoperative sleep, and perioperative oligoopioids or no opioid in elderly patients can promote postoperative recovery. To reduce the use of opioids, this study was to investigate the effect of perioperative intravenous lidocaine analgesia on the postoperative sleep of elderly patients undergoing laparoscopic radical resection for colorectal cancer.

Methods 63 patients aged 65-80 years with body mass index (BMI) values of 20-30 kg/m^2 and American society of anesthesiologists (ASA) grades of II-III, who underwent elective laparoscopic radical resection for colorectal cancer, were selected. The patients were divided into the lidocaine group (group L, n = 32) and the control group (group C, n = 31) by using a random number table. Patients in both groups received total intravenous anesthesia. In group L, a dose of 1.5 mg/kg of lidocaine was injected intravenously during induction of anesthesia, and lidocaine (1.0 mg·kg^{-1}·h^{-1}) was injected intravenously during surgery and for 24 hours after surgery. In Group C, the same volume of normal saline was injected, and intravenous patient-controlled analgesia (Sufentanil 1.5-1.8 μg/kg) was given after surgery. The Pittsburgh Sleep Quality Index (PSQI) was used to evaluate the sleep function 1 d before surgery, 1 d, 2 d, and 3 d after surgery. The incidence of postoperative sleep disturbance (POSD) at 1 d, 2 d and 3 d after surgery was calculated. The pain intensity of the two groups at different time points after surgery was evaluated. The intraoperative consumption of opioids and propofol and the incidence of postoperative complications and lidocaine adverse reactions in 2 groups were recorded.

Results Compared with group C, sleep quality, sleep latency, sleep duration, sleep efficiency, sleep disturbance, daytime dysfunction scores, and total PSQI score was improved significantly in group L at 1 d, 2 d, and 3 d after surgery (P <0.05). Compared with group C, the incidence of POSD in group L was lower, and the difference was statistically significant (P <0.05). There was no significant difference in postoperative pain intensity between the two groups (P > 0.05) Compared with group C, the consumption of opioids and propofol in group L decreased significantly (P <0.05). There was no statistically significant difference in the incidence of postoperative complications. No patient in group L had side effects of lidocaine.

Conclusions For elderly patients undergoing laparoscopic radical resection of colorectal cancer, perioperative intravenous lidocaine infusion can improve the early postoperative sleep quality, reduce the incidence of postoperative sleep disturbance, and promote the recovery of postoperative sleep function.

Introduction

Postoperative sleep disturbance (POSD) is a key factor affecting the rapid postoperative recovery of patients with colorectal cancer [1], and poor postoperative pain control often leads to POSD[2]. Opioids are the most commonly used analgesics during the perioperative period, but they have side effects such as nausea and vomiting, respiratory depression, constipation, urinary retention, and delayed recovery of gastrointestinal function, and can also disturb postoperative sleep[3]. Epidural analgesia is the most reliable method for postoperative pain control after abdominal surgery, but its management is troublesome and is limited by postoperative anticoagulation therapy. Studies have shown that perioperative intravenous lidocaine infusion can produce the same analgesic effect as epidural analgesia[4], and can reduce the application of perioperative opioids[5]. However, whether perioperative intravenous lidocaine infusion can improve postoperative sleep in elderly patients by relieving postoperative pain is not yet confirmed. We hypothesized that perioperative intravenous lidocaine infusion can reduce the perioperative dose of opioids, relieve postoperative pain, and improve postoperative sleep in elderly patients undergoing laparoscopic radical resection for colorectal cancer.

Methods

This study was approved by the hospital ethics committee (No. 2020 – 312), was registered in the Chinese clinical trial (ChiCTR2000038184), and informed consent forms were signed by the patient or family members. All methods were performed in accordance with the relevant guidelines and regulations in our present study. The inclusion criteria of our trial included elderly patients aged 65–80 years with BMI values of 20–30 kg/m^2 and ASA grades of II-III, who underwent elective laparoscopic radical resection for colorectal cancer in Ningxia Medical University from October 2020 to April 2021. The exclusion criteria included those who are allergic to lidocaine, have preoperative sleep disorder or obstructive sleep apnea, have preoperative atrioventricular block and bradycardia, have kidney or liver function impaired, have severe respiratory diseases and neurological or mental disorders, have long-term use of opioids or tranquilizers, have excessive anxiety and depression. Patients with the following states were excluded during the study: conversion to laparotomy, operation time > 4 hours, postoperative delivery to ICU, and incomplete follow-up data.

Patients were randomly allocated to two groups based on computer-generated codes that were maintained in sequentially numbered opaque envelopes. Allocation envelopes were opened by a pharmacy staff member who then prepared either 2% lidocaine or saline in coded 50-ml syringes. The anesthesiologist in charge of the case was unaware of the patient's group assignment; the study was thus fully double blinded. Patients in L group received intravenous injection of lidocaine 1.5 mg/kg at the time of anesthesia induction according to ideal body weight, and continued intravenous infusion of lidocaine 1.0 mg·kg^{-1}·h^{-1} to maintain postoperative analgesia 24 h after surgery. Group C was given equal volume normal saline and patient-controlled intravenous analgesia after surgery. General anesthesia was induced with 0.02 mg/kg midazolam, 0.3–0.5 μg/kg sufentanil, 0.2–0.4 mg/kg etomidate, and 0.06 mg/kg rocuronium. After 3 minutes, tracheal intubation was performed, and mechanical ventilation was carried out after confirming the position of the tracheal tube. Ventilator parameters: VT was 6–8 mL/kg, RR was 12–16 times/min, I: E was 1:2, FiO2 was 60%, positive end-expiratory pressure (PEEP) was 5 cmH2O; PETCO2 was maintained at 35–45 mmHg. Anaesthesia was maintained by continuous infusion of propofol (4–6 mg·kg-1·h-1) and remifentanil (0.05–0.2 μg·kg-1·min-1), and 10–20 mg/h of rocuronium was administered intermittently during surgery to maintain the bispectral Index (BIS) value between 40 and 60. Muscle relaxants were stopped 30 minutes prior to the end of the surgery, and medication for the maintenance of

general anesthesia was stopped at the end of surgery. After the patient's consciousness and protective reflexes were restored, VT was > 6 mL/kg, respiratory rate (RR) was 12–20 times/min, and oxygen saturation (SpO2) was > 95%, the tracheal tube was removed and the patient was sent to post anesthesia care unit (PACU). In addition, patients in group L received an intravenous injection of lidocaine (1.5 mg/kg) during induction of anesthesia according to their ideal body weight, and lidocaine (1.0 mg·kg-1·h-1) was injected intravenously during surgery and for 24 hours after surgery. In Group C, the same volume of normal saline was injected, and intravenous patient-controlled analgesia was given after surgery. The formula was that 1.5–1.8 μg/kg of sufentanil was diluted with normal saline to 100 mL, the background dose was 2 mL/h, the single infusion volume was 0.5 mL, and the lock time was 15 minutes. Intravenous injection of 40 mg parecoxib sodium was provided for remedial analgesia after surgery, for patients with contraindications to parecoxib sodium, intramuscular injection of diclofenac sodium injection 50 mg.

The primary endpoints in our study included the Pittsburgh Sleep Quality Index (PSQI) was used to evaluate the occurrence of sleep disturbance on the 1st, 2nd, and 3rd day after surgery. The PSQI scale includes 7 components: sleep quality, sleep latency, sleep duration, sleep efficiency, sleep disturbance, sleep medication, and daytime dysfunction. In scoring the PSQI, seven component scores are derived, each scored 0 (no difficulty) to 3 (severe difficulty), the component scores are summed to produce a global score (range 0 to 21), higher scores indicate worse sleep quality; good sleep is < 7 points, while sleep disturbance is ≥ 7 points[6]. The incidences of sleep disturbance at 1 d, 2 d, and 3 d after surgery were calculated in the two groups. The secondary endpoints included the visual analog scale (VAS) was used to evaluate the pain-at-rest and pain-on-movement of patients at 2 h, 4 h, 6 h, 12 h, 24 h, 48 h, and 72 h after surgery (0: no pain; 1–3: mild pain; 4–6: moderate pain; 7–10: severe pain). The consumption of intraoperative propofol and remifentanil. Postoperative intestinal function recovery index included the first time to get out of bed, the first time to exhaust, the first time to defecate, and the first time to eat. The postoperative complications including postoperative nausea and vomiting (PONV), respiratory and circulatory system complications, intestinal obstruction, and side effects of lidocaine (dizziness, drowsiness, tinnitus, convulsions,) were observed.

Sample size calculation

The incidence of postoperative sleep disturbance was taken as the main observation indicator. Our pre-experiment showed that intravenous lidocaine infusion could improve postoperative sleep function, the incidence of postoperative sleep disturbance in group C was 71%, and the incidence of postoperative sleep disturbance in group L was 35% (α = 0.05, 1-β = 0.8, two-sided test). PASS 15 software was used to calculate the sample size, N1 = N2, which showed that at least 27 cases should be included for each group. The expected dropout rate was 15%, so 31 cases were eventually included in each group.

Statistical analysis

SPSS 20.0 software was used for statistical analysis. Normally distributed measurement data were expressed as mean ± standard deviation ($\bar{x} \pm s$), and the t-test was used for group comparison; skewed measurement data were expressed by the median and interquartile range [M (IQR)], and the Wilcoxon rank-sum test was used for comparison between groups. Count data were expressed as the number of cases or percentage (%), and the $\chi 2$ test or Fisher's exact test was used for the comparison between groups to calculate the exact probability. $P < 0.05$ was considered statistically significant.

Results

In this study, 113 patients were enrolled according to the inclusion criteria, 38 patients were excluded according to the exclusion criteria (including 21 patients with preoperative vital organ dysfunction, 4 patients with a severe mental disorder, and 13 patients with sinus bradycardia), and 12 patients were excluded during the study (including 4 patients requiring conversion to open surgery, 2 patients in each group; 2 patients whose operation time was > 4 hours, 1 patient in each group; 4 patients who were sent to ICU after surgery, 2 patients in each group; 2 patients with incomplete follow-up data, 1 patient in each group), finally, 32 patients in the group L and 31 patients in group C were analyzed (Fig. 1).

There were no statistically significant differences between the two groups in gender, age, BMI, ASA classification, duration of anesthesia, operation time, intraoperative fluid infusion, intraoperative blood loss, and urine output ($P > 0.05$, Table 1).

Table 1
Comparison of general information of the two groups of patients (cases or x±s)

Groups	Cases	Gender (M/F)	Age (years)	BMI (kg/m)	ASA (/)	Duration of anesthesia (h)	Operation time (h)	Intraoperative fluid infusion (mL)	Intraoperative blood loss (mL)	Urine output (mL)
Group C	31	18/13 18/13 0.439	608 ± 8.3	24.0 ± 2.5	18/14	4.2 ± 0.3	3.5 ± 0.4	2046.9 ± 464.2	120.6 ± 89.3	503.4 ± 264.1
Group L	32	22/10	68 ± 8.1	24.9 ± 3.0	17/14	4.1 ± 0.5	3.3 ± 0.5	2140.0 ± 386.5	122.6 ± 63.0	521.0 ± 359.8
t/Z value		0.776	-0.484	0.177	0.013	-1.551	-0.430	0.855	0.100	0.220
P value		0.439	0.976	0.934	0.910	0.126	0.830	0.396	0.921	0.827

Note: ASA: American Society of Anesthesiologists classification BMI: Body Mass Index

Compared with group C, the amount of propofol and remifentanil used during surgery in group L was significantly reduced ($P < 0.05$, Table 2).

Table 2
Comparison of intraoperative propofol and remifentanil consumption between two groups of patients (x±s)

Groups	Cases	Propofol consumption (mg)	Sufentanil consumption (μg)
Group C	31	1601.2 ± 241.2	3146.0 ± 356.0
Group L	32	1376.8 ± 247.1	2695.2 ± 380.4
t value		3.647	4.864
P value		0.001	0.000

Note: Compared with the group C, $P < 0.05$

Compared with the preoperative data, the sleep quality, sleep latency, sleep duration, sleep efficiency, sleep disturbance, daytime dysfunction scores, and total PSQI scores were significantly increased at 1 d, 2 d, and 3 d after surgery in the two groups ($P < 0.05$). There were no significant differences between the data obtained 1 d after surgery and that obtained 2 d after surgery in the sleep quality, sleep duration, sleep efficiency, and daytime dysfunction scores of patients in the group L ($P > 0.05$), while the sleep quality, sleep duration, sleep efficiency, daytime dysfunction scores, and total PSQI score of patients in the group, C was significantly increased 2 d after surgery compared with the data obtained 1 d after surgery ($P < 0.05$). 3 days after surgery, the sleep latency, sleep efficiency, sleep disturbance scores, and total PSQI scores of patients in the two groups were significantly reduced ($P < 0.05$). There were no significant differences between the data obtained 2 d after surgery and that obtained 3 d after surgery in the sleep quality, sleep duration, sleep efficiency, and sleep disturbance scores of patients in the two groups ($P > 0.05$). Compared with group C, the sleep quality, sleep latency, sleep duration, sleep efficiency, sleep disturbance, daytime dysfunction scores, and PSQI score of patients in the group, L was significantly reduced 1 d, 2 d, and 3 d after surgery ($P < 0.05$, Table 3).

Compared with the preoperative data, the incidence of sleep disturbance at 1 d, 2 d, and 3 d after surgery in group C was significantly increased, and the incidence of sleep disturbance at 1 d after surgery in group L was significantly increased ($P < 0.05$). Compared with the data obtained at 1 d after surgery, the sleep of patients in group L returned to the preoperative level at 2 d and 3 d after surgery ($P < 0.05$). Compared with group C, the incidence of sleep disturbance was significantly decreased at 1 d, 2 d, and 3 d after surgery in group L ($P < 0.05$, Table 4).

Table 3
Comparison of scores of different items of PSQI scale and total PSQI score between two groups of patients at different time points [Min, *M (IQR)*]

Items	Groups	Cases	Before surgery	1 d after surgery	2 d after surgery	3 d after surgery
Sleep quality score	Group C	31	1(0–1)	2(1–3)^{ad}	2(1–2)^{ad}	2(1–2)^{ad}
	Group L	32	1(0–1)	1(1–1)^{a}	1(1–1)^{a}	1(1–1)^{a}
Sleep latency score	Group C	25	0(0–1)	2(1–3)^{ad}	2(2–3)^{ad}	1(0–1)^{abc}
	Group L	25	0(0–1)	1(1–1)^{a}	1(1-1.75)^{a}	1(0.25-1)^{ab}
Sleep duration score	Group C	25	0(0–1)	2(1–3)^{ad}	1(1–2)^{ad}	1(1–2)^{a}
	Group L	25	1(1–2)	1(1–1)	1(1–1)	1(1–1)
Sleep efficiency score	Group C	31	1(1–1)	2(1–3)^{ad}	1(1–2)^{ad}	1(1–2)^{ad}
	Group L	32	1(1–1)	1(1–1)^{a}	1(1–1)^{a}	1(0–1)^{abc}
Sleep disturbance score	Group C	31	0(0–1)	2(1–3)^{ad}	1(0–3)^{ab}	1(0–2)^{abd}
	Group L	32	0(0–1)	1(1–1)^{a}	1(0–1)^{a}	0(0–1)^{ab}
Sleep medication score	Group C	31	0(0–0)	0(0–0)	0(0–0)	0(0–0)
	Group L	32	0(0–0)	0(0–0)	0(0–0)	0(0–0)
Daytime dysfunction score	Group C	31	0(0–0)	2(1–3)^{ad}	1(1–2)^{abd}	1(1–2)^{abd}
	Group L	32	0(0–0)	1(1–1)^{a}	1(1–1)^{a}	1(0–1)^{abc}
Total PSQI score	Group C	31	3(2–6)	10(6–16)^{ad}	6(6–10)^{abd}	6(6–12)^{abd}
	Group L	32	3(2–4)	6(5–7)^{a}	4(4–6)^{ab}	4(4–5)^{ab}

Note: PSQI: Pittsburgh Sleep Quality Index; compared with preoperative data, $^{a}P < 0.05$; compared with the data obtained 1 day after surgery, $^{b}P < 0.05$; compared with the data obtained 2 days after surgery, $^{c}P < 0.05$; compared with group C, $^{d}P < 0.05$.

Table 4
Comparison of the incidence of postoperative sleep disturbance between the two groups [cases (%)]

Groups	Cases	Before surgery	1 d after surgery	2 d after surgery	3 d after surgery
Group C	31	4(12.90)	16(48.39)	12(38.71)	12(38.71)
Group L	32	4(12.50)	7(22.58)	4(15.63)	4(15.63)
X^2 value		0.002	6.007	5.709	5.709
P value		0.962	0.014	0.017	0.017
Note: Compared with group C, $P < 0.05$					

Compared with group C, the first time to get out of bed, the first time to exhaust, the first time to defecate, and the first time to eat were significantly shortened in group L (P < 0.05, Table 5).

Table 5

Comparison of postoperative rapid recovery index between two groups (x̄±s)

Groups	Cases	First time of out bed (d)	First exhaust time (d)	First defecation time (d)	First eating time (d)
Group C	31	0.91 ± 0.16	1.91 ± 0.17	2.62 ± 0.31	3.30 ± 0.33
Group L	32	0.81 ± 0.17	1.80 ± 0.16	2.44 ± 0.32	3.13 ± 0.34
t value		-2.388	-2.502	2.192	2.041
P value		0.200	0.015	0.032	0.046

Note: Compared with group C, $P < 0.05$

Compared with group C, the VAS scores in group L at rest and on movement 2 h after surgery were significantly reduced (P < 0.05). There were no significant differences in the VAS scores between the two groups of patients at rest and on movement at 4 h, 6 h, 12 h, 24 h, and 72 h after surgery (P > 0.05, Tables 6, 7).

Table 6
Comparison of the VAS scores at rest between the two groups of patients at different time points [Min, M (IQR)]

State	Groups	Cases	T1	T2	T3	T4	T5	T6	T7
At rest	Group C	31	1(0–3)[a]	2(1–3)	2(1–3)	2(1–3)	3(1-3.5)	2(1–3)	2(1–2)
	Group L		3(2–4)[a]	3(2–4)	3(2–3)	2(1.75-3)	2(1–3)	2(1–3)	2(1–3)
Z value			-2.594	-1.922	-0.996	-0.148	-0.434	-0.368	-1.332
P value			0.009	0.055	0.319	0.883	0.664	0.713	0.183

Table 7
Comparison of the VAS scores on movement between the two groups of patients at different time points [Min, M (IQR)]

State	Groups	Cases	T1	T2	T3	T4	T5	T6	T7
On movement	Group C	32	3(1.5–5.5)[a]	4(2-5.5)	4(2–5)	4(3–6)	5(3–6)	4(3.5-6)	4(3-4.5)
	Group L		4.5(3.75–6.25)[a]	4(3–6)	4(3.75-6)	4(3–6)	4(3–6)	4(3–6)	4(3–6)
Z value			-2.406	-1.102	-1.378	-0.578	-1.117	-0.385	-1.291
P value			0.016	0.271	0.168	0.564	0.264	0.700	0.197

Note: T1: 2h after surgery, T2: 4h after surgery, T3: 8h after surgery, T4: 12h after surgery, T5: 24h after surgery, T6: 48h after surgery, T7: 72h after surgery; compared with group C, [a]$P < 0.05$.

In group C, remedial analgesia was carried out for 3 cases 1 day after surgery, 4 cases 2 days after surgery, and 2 cases 3 days after surgery. In group L, remedial analgesia was carried out for 2 patients on the 1st day after surgery, 6 patients on the 2nd day after surgery, and 2 patients on the 3rd day after surgery. In group C, 8 patients had PONV, 1 had intestinal obstruction, 1 had a lung infection, and 1 had arrhythmia; in group L, 3 patients had PONV, 1 had a lung infection, and 1 had arrhythmia. There were no statistically significant differences between the two groups in the incidences of PONV, ileus, intestinal obstruction, and respiratory and circulatory system complications. No patients in group L had side effects of lidocaine.

Discussion

The prevalence of sleep disturbance in elderly patients increases with increasing age[7]. Surgical factors and postoperative pain are the key factors affecting the postoperative sleep of patients undergoing surgery[1]. This study evaluated for the first time the effect of perioperative intravenous lidocaine infusion on the postoperative sleep in elderly patients undergoing laparoscopic radical resection for colorectal cancer. The results showed that the perioperative intravenous lidocaine infusion was as effective as the postoperative intravenous analgesia pump, which improved the quality of early postoperative sleep reduced the incidence of postoperative sleep disturbance and promoted the recovery of postoperative sleep function.

Patient factors, anesthesia factors, surgical factors, postoperative pain, environmental factors, psychological factors, etc. all affect the postoperative sleep of patients undergoing surgery. Therefore, this study only included elderly patients, and the general conditions and preoperative comorbidities of the two groups of patients were comparable. The two groups of patients were treated by the same group of anesthesiologists and surgeons, and the anesthesia management and surgical procedure for the two groups of patients were comparable. We excluded patients with severe neurological, mental, and psychological disorders before surgery. In this study, the PSQI scale was used to assess sleep status. This scale is the most commonly used tool for domestic and foreign scholars to study sleep disturbance. The sensitivity of this scale to diagnose sleep disturbance is 89.6% and the specificity is 86%[6]. Sleep quality, sleep latency, sleep duration, sleep efficiency, sleep disturbance, sleep medication, and daytime dysfunction are 7 components to evaluate sleep, but the results may be disturbed by subjective factors.

In this study, patients in the lidocaine group received an intravenous injection of lidocaine (1.5 mg/kg) during induction of anesthesia and lidocaine (1.0 $mg \cdot kg^{-1} \cdot h^{-1}$) was injected intravenously during surgery and for 24 hours after surgery. This administration protocol is based on international expert consensus of intravenous lidocaine infusion [8]. Studies have shown that perioperative continuous infusion of lidocaine has the highest incidence of adverse reactions affecting the nervous system of patients[9]. Therefore, in consideration of the possible impact of this on our observational indicators, we adopt continuous infusion of low-dose lidocaine. In addition, we randomly selected 5 patients and obtained their arterial blood to test the highest level of plasma lidocaine (4.0 ± 0.5 μg/mL) at 1 min, 2 min, 3 min, and 5 min after the intravenous injection of lidocaine, 1 h, and 2 h during surgery, and 6 h, 12 h, and 24 h after surgery. The plasma lidocaine levels of all patients were lower than the reported toxic dose level of lidocaine (5 μg/mL)[8], which were in the safe dose range, so no side effects were observed in patients in the lidocaine group.

The results of this study show that intravenous lidocaine infusion can improve the early postoperative sleep quality of elderly patients undergoing laparoscopic radical resection for colorectal cancer, reduce the incidence of postoperative sleep disturbance, and promote the recovery of postoperative sleep function. The possible reason is that the perioperative intravenous application of lidocaine effectively relieves the postoperative pain-at-rest and pain-on-movement. The relationship between pain and sleep involves a variety of one-way or two-way interactions. Postoperative pain can lead to difficulty in falling asleep and easy awakening during sleep, which can lead to sleep disorders; on the contrary, postoperative pain is affected by sleep disorders and leads to hyperalgesia [11], which increases pain and forms a vicious cycle. Acute and chronic pain are associated with sleep disruption, and sleep disruption or shortening will in turn change pain perception [12]. Studies[4, 13, 14] have shown that for patients with abdominal surgery, the postoperative analgesic effect of intravenous lidocaine infusion is satisfactory, and the effect is consistent with epidural analgesia and intravenous patient-controlled analgesia. This study also confirmed that both pain-at-rest and pain-on-movement can be effectively controlled in the two groups of patients. Intravenous lidocaine infusion may be used to improve postoperative sleep by reducing opioids. Recently, many studies[15–18]have shown that perioperative intravenous lidocaine infusion can significantly reduce the demand for opioids during abdominal surgery. Opioids have a wide range of physiological effects, including significant analgesia[19] and sleep disturbance[20, 21], which indicates that opioids can affect sleep while reducing pain and even exaggerate postoperative sleep disturbance[12].

A large amount of evidence indicates that opioids have potentially harmful effects on sleep, which may impair sleep and sleep structure[20, 22]. There are four types of endogenous opioid receptors in central nervous system: μ, δ, κ and σ receptors. Three types of opioids, enkephalins, endorphins, and kephalins, have been shown to play a role in the initiation and maintenance of sleep, and the attenuation of arousal and wakefulness[23], but the mechanisms by which opioids act on sleep control remain unclear. It has been hypothesized that opioids bind to the peptide neurohormone vasopressin and participate in the induction and maintenance of sleep state through the complex and modifiable circadian mechanism driven by the suprataccipital nucleus (SCN)[24]. Vasopressin is a neurohormone in the pacemaker suprascial nucleus (SCN) of circadian rhythm, which has been proved to be closely related to circadian rhythm[25]. There is growing evidence that opioids affect sleep by acting on systems that promote sleep and wake up. Studies have shown that opioid-induced sleep disorders may be related to local adenosine levels in pons network (PRF) and basal forebrain (BF)[26].

In addition, the improvement of postoperative sleep in the lidocaine group is also related to the anti-inflammatory effect of lidocaine[27]. Postoperative pain can lead to the release of a variety of inflammatory mediators in the body, such as interleukin-6 (IL-6), tumor necrosis factor, C-reactive protein, etc. The increase of plasma interleukin-6 level can increase the incidence of sleep disorders by reducing sleep time and increasing fatigue[28]. However, the increase of TNF and C-reactive protein levels may be related to the activation of sympathetic effector pathways, leading to postoperative sleep disorder[29, 30]. Ortiz et al.[31] showed that intravenous lidocaine reduced IL-1, IL-6 and TNF- α levels. Siqi Xu1 et al.[32] also confirmed that perioperative addition of lidocaine can significantly reduce plasma Levels of IL-1, IL-6 and TNF- α. Therefore, intravenous lidocaine infusion during the perioperative period can improve the postoperative sleep of patients through its anti-inflammatory effect too.

Although the results of this study show that intravenous lidocaine infusion can significantly improve the postoperative sleep of elderly patients undergoing laparoscopic radical resection for colorectal cancer, this study also has the following limitations: (1) PSQI assessment of sleep quality may be affected by subjective factors, if this study had been combined with polysomnography to objectively assess the patient's perioperative sleep quality, the results would have been more reliable. However, polysomnography is temporarily not available for postoperative patients in our hospital. (2) There are many factors that affect postoperative sleep function. Postoperative mental status may also affect postoperative sleep function. This study only evaluated the preoperative mental state of the two groups of patients and excluded patients with severe mental disorders before surgery. However, the postoperative mental status of the patients was not evaluated. (3) This study did not thoroughly explore the specific mechanism of intravenous lidocaine infusion that improves postoperative sleep, which should be further studied in the future. (4) This is a single-center study with small sample size, and the results of the study should be confirmed by multi-center studies with large samples.

Conclusions

In conclusion, for elderly patients undergoing laparoscopic radical resection of colorectal cancer, perioperative intravenous lidocaine infusion may improve the early postoperative sleep quality, reduce the incidence of postoperative sleep disturbance, and promote the recovery of postoperative sleep function by effective postoperative analgesia, reducing the opioid dosage.

Abbreviations

Postoperative sleep disturbance (POSD), body mass index (BMI), Pittsburgh Sleep Quality Index (PSQI), visual analog scale (VAS), bispectral Index (BIS), positive end-expiratory pressure (PEEP), post anesthesia care unit (PACU)

Declarations

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Not applicable

Authors' contributions

Xiaomei Wang contributed to study design, data collection, statistical analysis, drafting the manuscript. Liqin Deng contributed to study design and revised the manuscript. Yanan Wu and Lu Wang contributed to data collection and statistical analysis. Haitao Hou and Yuxue Qiu were participated in the design of the study and was responsible for clinical coordination. All authors read and approved the final manuscript.

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Our own money.

Availability of data and materials

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

Ethics approval and consent to participate

This study was approved by the Institutional Medical Ethics Committee of The Ningxia Medical University General Hospital. Written informed consent was obtained from all subjects. This study was registered in the Chinese Clinical Trial Registry ((ChiCTR2000038184). Initial registration date was 12/09/2020.

Consent for publication

Not applicable.

Competing interests

The authors declare that they have no competing interests.

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Figures

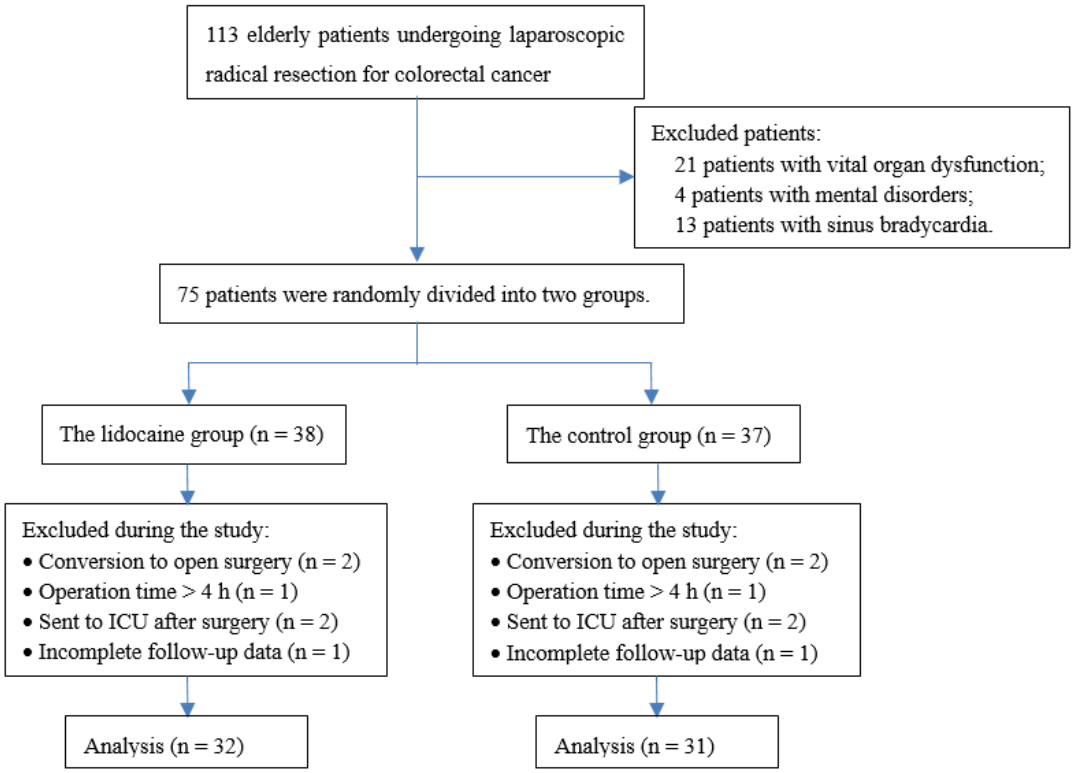

Figure 1

Flow chart of case screening

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