Research Square

Preprints are preliminary reports that have not undergone peer review.
They should not be considered conclusive, used to inform clinical practice,
or referenced by the media as validated information.

Analysis of the effect of oxycodone preadministration timing on clinical anesthesia in laparoscopic surgery: a randomized clinical trial

Qigang Ma
The First Affiliated Hospital of Anhui Medical University
Gui Gao
Lu 'an Hospital of Traditional Chinese Medicine
Zhikun Chen
Lu 'an Hospital of Traditional Chinese Medicine
Yan Wu
Lu 'an Hospital of Traditional Chinese Medicine
Xue Tan
Lu 'an Hospital of Traditional Chinese Medicine
Guanghong Xu
yfy102901@fy.ahmu.edu.cn

The First Affiliated Hospital of Anhui Medical University

Research Article

Keywords: Acute postoperative pain, Oxycodone, quality of recovery, Haemodynamics, laparoscopic cholecystectomy

Posted Date: September 3rd, 2026

DOI: https://doi.org/10.21203/rs.3.rs-10473710/v1

License: This work is licensed under a Creative Commons Attribution 4.0 International License.
Read Full License

Additional Declarations: No competing interests reported.

Abstract

Background

preemptive oxycodone can effectively alleviate acute and chronic postoperative pain.This study aimed to investigate the effects of different timing preemptive oxycodone on the 24-hour postoperative recovery quality in patients undergoing laparoscopic cholecystectomy.

Method

A total of 178 patients undergoing laparoscopic cholecystectomy were randomly divided into Group A and Group B. Patients in Group A (n = 89) received intravenous oxycodone 0.1 mg/kg 10 minutes before induction, while patients in Group B (n = 89) received intravenous oxycodone 0.1 mg/kg 10 minutes before the end of surgery (immediately at skin closure). QoR-15 scores were assessed at baseline and 24 hours post-surgery. Hemodynamic variables were recorded throughout surgery and during the stay in the postanesthesia care unit (PACU).Eye-opening time, extubation time, orientation recovery time, PACU stay duration, and adverse reactions during the PACU period were also recorded for both groups.

Results

At 24 hours postoperatively, the overall QoR-15 score in Group B (126 [124, 127]) showed no statistically significant difference compared with Group A (125 [123, 126]) *(P > 0.05)*. Compared with Group B, Group A had significantly shorter eye-opening time (11 [8, 14] vs. 15 [9, 18]; *p < 0.001*), extubation time (13 [9, 15] vs. 17 [12, 20]; *p < 0.001*), and orientation recovery time (19 [14, 22] vs. 22 [17, 25]; *p < 0.001*). The PACU length of stay in Group A was also shorter than that in Group B (49 [36, 52] vs. 55 [42, 78]; *p < 0.019*), and the incidence of PACU length of stay exceeding 60 minutes was lower in Group A compared with Group B (2 [5%] vs. 10 [26%]; *p < 0.02*).

Conclusions

In patients undergoing laparoscopic cholecystectomy, the overall quality of recovery at 24 hours postoperatively was comparable between patients receiving oxycodone either before induction or at skin closure. However, pre-induction administration was associated with shorter eye-opening time, extubation time, time to orientation recovery, and PACU length of stay.

Trial registration: Chinese Clinical Trial Registry ChiCTR2300078324.Registered on 2023-12-05.

Background

With rising patient demands for better postoperative recovery and improved cosmesis, there has been a marked shift toward laparoscopic approaches for cholecystectomy [1]. Under the Enhanced Recovery After Surgery (ERAS) framework, the ability to attenuate perioperative stress and optimize postoperative recovery now serves as essential metrics for gauging surgical success and guiding approach selection [2,

[3]. While minimally invasive surgery minimizes external trauma, its postoperative pain profile is nevertheless predominantly characterized by visceral components [4]. Postoperative visceral pain can activate various metabolic, hormonal,inflammatory, and immune responses [5], which may increase the risk of postoperative complications and reduce patients' quality of life. Therefore, postoperative pain management is of critical importance.

Preventive analgesia suppresses activation of the sympathetic nervous system and reduces the synthesis and release of inflammatory cytokines, thereby attenuating pain induced by surgical trauma, optimizing postoperative outcomes, and facilitating early recovery [6,7].Oxycodone is a potent opioid analgesic with dual μ-and κ-receptor agonist effects [8], and its mechanism of action is relatively unique.On one hand, it binds to μ-opioid receptors at presynaptic terminals within the central nervous system, inhibiting the transmission of nociceptive stimuli from afferent nerve fibers to spinal dorsal horn neurons and thereby exerting analgesic effects [9]. On the other hand, it acts on κ-receptors in smooth muscle, modulating visceral referred pain from abdominal organs, and thus possesses distinctive advantages in alleviating perioperative visceral pain [10].

This study adopted the QoR-15 score as the primary outcome to evaluate how the timing of prophylactic oxycodone administration affects recovery quality following laparoscopic cholecystectomy, with the findings expected to inform perioperative pain management strategies.

Materials and Methods

Study Design

This randomised controlled trial was reported in accordance with the Consolidated Standards of Reporting Trials (CONSORT) 2025 guidelines.We conducted a prospective, double-blind, randomized controlled clinical trial. This study was approved by the Ethics Committee of Lu'an Hospital of Traditional Chinese Medicine, the Fifth Affiliated Hospital of Anhui University of Chinese Medicine (Approval No. LASZYY-LL-KY-2023001), and was registered with the Chinese Clinical Trial Registry (http://www.chictr.org.cn) prior to patient enrollment (Registration No. ChiCTR2300078324; initial registration date: 5th December 2023). Written informed consent was obtained from all participants. This trial enrolled patients aged 18–65 years, with American Society of Anesthesiologists (ASA) physical status I–II (I: healthy patient; II: patient with mild systemic disease), who underwent laparoscopic cholecystectomy at Lu'an Hospital of Traditional Chinese Medicine, between 5th December 2023 and 1th December 2024. Exclusion criteria were as follows: refusal to participate in the study; history of asthma, chronic cough, or chronic bronchitis with recent acute exacerbation. Group allocation was performed using a computer-generated randomization table, followed by preparation of numbered opaque sealed envelopes by the investigator.All patients received standard perioperative surgical safety verification, including a mandatory intraoperative time-out involving the entire core operative team: surgeons, anesthesiologists, and nursing staff.Peripheral access was obtained and standard monitoring (blood

pressure, SpO_2, and ECG) was initiated prior to induction. All patients then received a baseline infusion of 500 mL lactated Ringer's solution. An independent researcher not involved in anesthesia care opened the envelope, prepared two 10-mL syringes (one oxycodone, one saline), and labeled them as "Study Drugs 1 and 2" to ensure allocation concealment.According to group assignment, "Study Drugs 1 and 2" were administered respectively at 10 minutes before induction and at 10 minutes before the end of surgery (immediately at skin closure). Group A received slow intravenous injection of oxycodone 0.1 mg/kg 10 min before anesthesia induction, and an equal volume of normal saline was slowly administered intravenously 10 min prior to the end of surgery (immediately at skin closure). In Group B, patients were given slow intravenous injection of oxycodone 0.1 mg/kg 10 min before the end of surgery (immediately at skin closure), while an equal volume of normal saline was slowly injected intravenously 10 min before induction [11,12,13]. Both groups received oxygen via nasal cannula at 2 L/min before anesthesia. At the 10-minute time point after drug administration general anesthesia was induced sequentially with intravenous midazolam 0.05 mg/kg, etomidate 0.3 mg/kg, sufentanil 0.5 μg/kg, and rocuronium 0.6 mg/kg, followed by manual mask ventilation with oxygen supplementation. When the bispectral index (BIS) value decreased to 40–60, tracheal intubation was performed and mechanical ventilation was initiated to maintain end-tidal carbon dioxide partial pressure between 35–45 mmHg. Anesthesia was maintained with remifentanil 0.05–0.15 μg/kg/min and propofol 1–2.5 mg/kg/h. Remifentanil and propofol were titrated to target both hemodynamic stability (HR and MAP within 20% of baseline) and adequate anesthesia depth (BIS 45–60).At the end of surgery, ondansetron 4 mg was intravenously administered upon admission to the PACU, and the tracheal tube was extubated after satisfactory muscle strength recovery.In post anesthesia care unit (PACU), flurbiprofen axetil 50 mg was administered as remedial anesthesia if NRS ≥ 4 and it could be repeated every 10 min until NRS ≤ 3.Allocation concealment was strictly maintained throughout the perioperative period. Patients, surgical and anesthesia providers, and PACU nursing staff remained blinded to group assignment throughout the study. Unblinding was performed only after patient discharge or in the case of an emergency.

Data Collection

The following data were collected: patient sex, height, age, American Society of Anesthesiologists (ASA) physical status, body mass index, duration of anesthesia, and operative time.The QoR-15 questionnaire was selected as the primary outcome measure—a patient-reported scale specifically designed to assess postoperative recovery, which has been rigorously validated in diverse surgical cohorts [14]. After obtaining written informed consent, the QoR-15 scoring system was explained in detail to all participants by a research assistant, who provided the baseline QoR-15 questionnaire and reviewed it with each subject to ensure accurate comprehension of all items. A follow-up QoR-15 assessment was performed at 24 hours postoperatively using the same instrument administered preoperatively.The QoR-15 comprises 15 items divided into two main dimensions: the positive dimension (Items 1–10), which assesses physiological comfort and functional recovery—including ease of breathing, appetite, sleep quality, and self-care ability—using a 0–10 scale (0 = extremely poor condition, 10 = excellent condition); and the negative symptom dimension (Items 11–15), which evaluates adverse symptoms such as pain,

nausea, and emotional distress using reverse scoring (0 = symptom present, 10 = symptom absent). The total score ranges from 0 to 150, with higher scores indicating better postoperative recovery quality.Additional data collected included mean arterial pressure (MAP) and heart rate (HR) at the following time points:before anesthesia induction (T0), At 3 minutes after intubation(T1), after pneumoperitoneum was achieved(T2), immediately after extubation(T3), and 5 min after extubation (T4). Eye-opening time, extubation time, orientation recovery time, and PACU length of stay, as well as the incidence of PACU stay exceeding 60 minutes and PACU-related adverse reactions, were documented for both groups.

Sample size calculation

Based on a previous study [15], 35 participants per group were required to have 80% power to detect a 17-point difference in QoR-40 scores between the two groups. Since the QoR-15 is a shortened version of the QoR-40 with fewer items, which may be slightly less sensitive to subtle differences under certain circumstances, a somewhat larger sample size may be needed to achieve the same statistical power to compensate for this; accordingly, a 12.75-point difference in QoR-15 scores was considered. A 10-point difference represents a 15% improvement in quality of recovery [16, 17]. To account for participant attrition, a total of 178 subjects were ultimately enrolled and allocated to the two groups according to a random sequence generated by an online random number generator.

Statistical analysis

SPSS software (version 26; IBM Corporation, Armonk, NY, USA) was used for the statistical analysis. Continuous variables are expressed as means with SDs or medians with interquartile ranges, as appropriate. Categorical variables are presented as counts (percentages). The Shapiro–Wilk test was used to assess the normality of data distribution. Normally distributed data were evaluated by one-way analysis of variance and post-hoc tests. Data with skewed distributions were analyzed using the Kruskal–Wallis test and pairwise multiple comparisons. Frequency data were analyzed using the chi-squared test. Non-normally distributed parameters were analyzed using the Mann–Whitney U test and are presented as median (interquartile range, IQR). Categorical variables are expressed as frequencies and percentages (%) and were compared using the chi-square test or Fisher's exact test, as appropriate. Hemodynamic variables at corresponding time points were analyzed using two-way repeated-measures analysis of variance. A p-value < 0.05 was considered statistically significant.

Results

Participants were recruited between 5th December 2023 and 1th December 2024. The CONSORT flow diagram of the study is presented in Fig. 1. Of the 200 patients (aged 18–65 years) evaluated for laparoscopic cholecystectomy, 22 were excluded, leaving 178 patients eligible for enrollment.The 178 patients were randomized to Group A (n = 89; median age 38 [IQR, 28–46]; 53/36 M/F) and Group B (n =

89; median age 38 [IQR, 32–49]; 57/32 M/F)(Table 1). There were no statistically significant between-group differences with respect to any of the baseline or intraoperative variables assessed, including patient demographics, ASA classification, operative time, anesthesia duration, and hemodynamic measurements obtained during both the surgical and PACU periods (Tables 1 and 2).

Table 1
Characteristics of the study sbjects

Primary outcome

The total QoR-15 scores at 24 hours postoperatively showed no statistically significant difference between the group A and group B [mean ± SD, (125.8 ± 3.82) vs. (125.2 ± 3.45); *P* = 0.635].Although the positive experience dimension score in group A was slightly lower than that in group B [mean ± SD, (81.50 ± 3.06)vs.(82.78 ± 3.25;*P* = 0.135], and the negative symptom dimension score in group A was slightly higher than that in group B [mean ± SD, (45.74 ± 2.07vs.44.98 ± 2.30*P* = 0.176] ,the difference between the two groups was not statistically significant(Table 3).

Table 3
Comparision of Quality of Recovery-15 Scores and Pacu study parameters

Secondary outcomes

Compared with Group B, Group A had significantly shorter eye-opening time (11 [8, 14] vs. 15 [9, 18]; $p < 0.001$), extubation time (13 [9, 15] vs. 17 [12, 20]; $p < 0.001$), and orientation recovery time (19 [14, 22] vs. 22 [17, 25]; $p < 0.001$)(Table 3). PACU length of stay was also shorter in Group A than in Group B (49 [36, 52] vs. 55 [42, 78]; $p < 0.019$), and the incidence of PACU length of stay exceeding 60 minutes was lower in Group A compared with Group B (2 [5%] vs. 10 [26%]; $p < 0.02$). There were no statistically significant differences between the two groups in the incidence of PACU-related PONV, post-extubation respiratory depression, or sore throat ($P > 0.05$; Table 3).

Discussion

With the advancement of enhanced recovery after surgery (ERAS) and minimally invasive techniques, perioperative research focus has shifted from merely improving surgical survival to optimizing postoperative recovery quality, which is now regarded as an essential endpoint for evaluating overall surgical outcomes.Preoperative oxycodone administered at 10 minutes before induction versus 10 minutes before surgical completion resulted in comparable 24-hour postoperative QoR-15 scores in

patients undergoing laparoscopic cholecystectomy.Pre-induction oxycodone significantly reduced times to eye opening, extubation, and orientation recovery; it also shortened PACU length of stay and reduced the incidence of PACU stay exceeding 60 minutes, compared with pre-completion administration.The QoR-15 is superior to a single VAS pain score for assessing perioperative recovery, as it evaluates five dimensions of recovery and thereby provides a more complete picture of integrated postoperative outcomes.Pain management is a cornerstone of enhanced recovery protocols. In this context, prophylactic oxycodone administered before surgical completion blocks pain signal transduction and prevents central sensitization, thereby significantly improving postoperative recovery quality in patients undergoing laparoscopic cholecystectomy [7,18,19]. Previous reports have shown that intravenous oxycodone given before the end of surgery improves QoR-15 scores and reduces opioid-related adverse effects after laparoscopic cholecystectomy [20,21]. However, the optimal timing of prophylactic administration remains controversial. This comparison of two preemptive administration time points confirms that pre-induction dosing facilitates postoperative recovery, specifically by shortening times to eye opening, extubation, and orientation recovery, as well as reducing PACU length of stay.

The QoR-15 is a core instrument for multidimensional recovery assessment, encompassing physical comfort, emotional state, pain, and functional independence. It provides an objective and comprehensive reflection of patients' overall postoperative rehabilitation status [22,11,23]. The unique attribute of oxycodone lies in its dual receptor agonism [24,25], which mediates its favorable postoperative recovery profile: κ-receptor activation is responsible for the precise blockade of visceral pain elicited by intra-abdominal manipulation and inflammatory insult; μ-receptor activation provides additive central analgesic effects. Both administration timings exert analgesic effects at critical perioperative junctures, effectively attenuating pain-related stress and its negative impact on patients' physiological and psychological well-being, thereby preserving high postoperative recovery quality [26,27.] These findings align closely with the expert consensus on clinical application of oxycodone, which advocates that "perioperative prophylactic oxycodone use can optimize postoperative analgesia and promote recovery." Additionally, the literature confirms [27] that at equivalent doses, the two preemptive timing strategies do not differ in long-term overall recovery outcomes, both achieving ideal prophylactic analgesia. Our results showed no statistically significant differences between groups in 24-hour overall QoR-15 scores, nor in the incidence of PACU nausea, vomiting, post-extubation respiratory depression, or sore throat.

Pre-induction oxycodone administration resulted in significantly shorter times to eye opening, extubation, and orientation recovery, as well as shorter PACU stay and lower incidence of PACU stay >60 minutes, compared with pre-surgical completion administration in this study. The underlying reasons are primarily related to oxycodone's pharmacokinetic properties and the differential drug concentration profiles conferred by administration timing. Oxycodone has a rapid onset after intravenous injection. Pre-induction oxycodone administration maintains stable plasma concentrations throughout induction and surgery. By preemptively inhibiting nociceptive transmission to the central nervous system, oxycodone suppresses the intraoperative pain-induced stress response, thereby avoiding increased anesthetic requirements.This consequently reduces total intraoperative anesthetic consumption and residual CNS

depression, thereby accelerating **eye-opening time**, extubation, and orientation recovery [26.] Pre-induction oxycodone administration maintains stable plasma concentrations throughout induction and surgery, preemptively inhibiting nociceptive transmission and reducing total anesthetic consumption. In contrast, administration at surgical completion causes the drug's peak effect to coincide with the emergence phase, thereby leaving the intraoperative period without optimal analgesic coverage while simultaneously delivering a sedative burden during awakening. Although this approach provides bridging postoperative analgesia, its central sedative and analgesic effects may mildly delay emergence. More importantly, because nociceptive stimuli are not preemptively blocked during surgery, a more pronounced intraoperative stress response ensues. These combined factors ultimately prolong emergence, extubation, and orientation recovery, thereby increasing both PACU stay duration and the rate of prolonged PACU stays [28]. Pre-induction oxycodone administration facilitates a smooth analgesic-to-anesthetic transition, thereby circumventing both inadequate intraoperative analgesia and delayed emergence attributable to excessive sedative load [29,30]. This strategy therefore aligns with core ERAS principles of rapid emergence, early extubation, and shortened PACU length of stay.Importantly, the two regimens demonstrated comparable safety profiles at equivalent intravenous doses, with no significant between-group differences in the incidence of postoperative nausea and vomiting, sore throat, or respiratory depression.

There are limitations in our study. First, this study enrolled only adult patients, excluding elderly and pediatric populations as well as those with hepatic or renal dysfunction—groups known to exhibit considerable interindividual variability in opioid metabolism and sensitivity. Second, our assessment was limited to 24-hour postoperative QoR-15 scores and PACU-related parameters, without extending follow-up to include longer-term outcomes such as pain intensity and gastrointestinal function recovery. This restricts our ability to comprehensively evaluate the two regimens' effects on sustained rehabilitation.Third, our investigation was limited to a single oxycodone dose of 0.1 mg/kg, without exploring alternative dose levels. This precludes optimization of the dose-timing interplay to maximize clinical benefit.Finally, the lack of detailed intraoperative inflammatory profiling and comprehensive stress-response phenotyping represents a mechanistic gap in the present study. Whether the observed clinical benefits of pre-induction administration are mediated through attenuation of the perioperative stress cascade remains an open question. Future efforts should prioritize large-sample, multicenter studies with extended follow-up to refine dose-timing strategies across heterogeneous patient populations. Future studies should incorporate perioperative stress and inflammatory cytokine monitoring to correlate mechanistic biomarkers with clinical outcomes, thereby paving the way for biomarker-guided, individualized analgesic strategies in laparoscopic surgery.

Conclusion

For patients undergoing laparoscopic cholecystectomy (LC), 0.1 mg/kg oxycodone administered 10 minutes before anesthesia induction versus 10 minutes prior to the end of surgery yields comparable 24-hour postoperative recovery quality. Nevertheless, pre-induction administration significantly accelerates

emergence, shortens extubation time, and reduces PACU length of stay, which aligns more closely with ERAS principles focused on rapid postoperative recovery.

Abbreviations

ERAS, Enhanced Recovery After Surgery; LC, laparoscopic cholecystectomy; PACU, Post-anesthesia Care Unit; QoR-15, 15-item Quality of Recovery questionnaire; RCT, randomized controlled trial.

Declarations

Ethics approval and consent to participate

This study was approved by the Ethics Committee of Lu'an Hospital of Traditional Chinese Medicine, the Fifth Affiliated Hospital of Anhui University of Chinese Medicine (Approval No. LASZYY-LL-KY-2023001). Written informed consent was obtained from all participants before enrolment.

Consent for publication

Not applicable.

Availability of data and materials

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

Competing interests

The authors declare that they have no competing interests.

Funding

The authors declare that no funds, grants, or other financial support were received for the conduct of this study.

Authors’ contributions

Qigang Ma drafted the original manuscript ,completed chart drawing ,performed data statistical analysis and data sorting; Gui Gao ,Zhikun Cheng,Yan Wu and Xue Tan Tcollected clinical data ; Guanghong Xu, designed the research framework, revised the manuscript critically. All authors read and approved the final manuscript.

Acknowledgements

We thank all patients who participated in this trial, as well as the nursing and anaesthesia staff working in the operating room and PACU for their support during data collection.

References

1. Johnson A: Laparoscopic surgery. Lancet 1997; 349:631–35
2. Jiao Qin,Ling-Yan Gou,Wei Zhang et al.Enhanced Recovery After Surgery versus Conventional Care in Cholecystectomy: A Systematic Review and Meta-Analysis[J].J Laparoendosc Adv Surg Tech A . 2024 34(8):710-20
3. Sun ZY, Ye L, Mao YY,et al.Effect of enhanced recovery after surgery nursing on gastrointestinal recovery function and life quality in patients laparoscopic cholecystectomy[J].World J Gastrointest Surg. 2025 17(11).108188-98.
4. Morten Rune Blichfeldt-Eckhardt,Helle Ording,Claus Andersen,et al.Early visceral pain predicts chronic pain after laparoscopic cholecystectomy[J].Pain . 2014 Nov;155(11):2400-07.
5. Kehlet H.Surgical stress: the role of pain and analgesia.Br J Anaesth. 1989;63(2):189-195.
6. Clarke H, Poon M, Weinrib A,et al.Preventive analgesia and novel strategies for the prevention of chronic post-surgical pain[J].Drugs. 2015 Mar;75(4):339-51.
7. Mario Nosotti,Lorenzo Rosso,Davide Tosiet al.Preventive analgesia in thoracic surgery: controlled, randomized, double-blinded study[J].Eur J Cardiothorac Surg,2015 Sep;48(3):428-33
8. Pasternak G W. Oxycodone: A Current Perspective on Its Pharmacology, Abuse, and Pharmacotherapeutic Developments[J]. Pharmacological Reviews, 2023,75(3):897-936.
9. Baowen Liu,Yi Liu,Ningbo Li et al. Oxycodone regulates incision-induced activation of neurotrophic factors and receptors in an acute post-surgery pain rat model[J]. J Pain Res. 2018;11:2801-2812.
10. Yi An,Lei Zhao,Tianlong Wang,et al.Preemptive oxycodone is superior to equal dose of sufentanil to reduce visceral pain and inflammatory markers after surgery: a randomized controlled trail[J].BMC Anesthesiol . 2019 Jun 11;19(1):96-03.
11. Wen-Tao Wu,Bo-Jing Xu,Bing Li,et al.Pre-emptive Oxycodone versus Sufentanil for Acute and Delayed Pain after Transcatheter Arterial Chemoembolization: A Randomized Controlled Trial with Inflammatory Biomarker Analysis[J].J Vasc Interv Radiol . 2026 May;37(5):108570-09.
12. Jinguo Wang,Haichun Ma,Honglan Zhou,et al.Effect of preoperative intravenous oxycodone administration on sufentanil consumption after retroperitoneal laparoscopic nephrectomy[J]. Anaesthesiol Intensive Ther . 2016;48(5):300-04.
13. Wang N, Wang Y, Pang L, Wang J.et al.Effect of preemptive analgesia with intravenous oxycodone in the patients undergoing laparoscopic resection of ovarian tumor[J].Pak J Med Sci. 2015 Mar-Apr;31(2):300-03
14. J Kleif,J Waage,K B Christensen, et al.Systematic review of the QoR-15 score, a patient-reported outcome measure measuring quality of recovery after surgery and anaesthesia[J].Br J Anaesth. 2018;120(1):28-36
15. Eduardo T Moro,Miller F Lambert,Ana Luiza Pereira, et al.The effect of methadone on postoperative quality of recovery in patients undergoing laparoscopic cholecystectomy: A prospective, randomized, double blinded, controlled clinical trial[J].J Clin Anesth . 2019 Mar:53:64-69.

16. Matthew Campbell,Daniel Ng,Batool Albatat, et al．Quality of recovery assessment of day case and multiday stay patients undergoing elective laparoscopic cholecystectomy[J]．J Clin Nurs, 2022; 31(11–12): 1688–97．
17. Paul S Myles,Mark A Shulman,Jennifer Reilly, et al．Measurement of quality of recovery after surgery using the 15-item quality of recovery scale: a systematic review and meta-analysis[J]．Br J Anaesth, 2022; 128(6): 1029–39．
18. Ye Wang,Meng Wu,Lin Zhao, et al．Comparison of the analgesic effects of oxycodone vs. sufentanil on postoperative pain after laparoscopic gallbladder-preserving cholecystolithotomy: a prospective randomized controlled trial[J]．Front Surg . 2024 Apr 24:11:1382759-66.
19. Li Zhou,Youchuan Zhang,Haotian Sun, et al．Effect of preemptive dezocine before general anesthesia on postoperative analgesia in patients undergoing laparoscopic cholecystectomy: A prospective observational study[J]．Medicine (Baltimore) . 2018 Sep;97(39):e12533-38.
20. Yejing Zhu,Kangjie Xie,Junbo Yuan, et al．Efficacy of oxycodone in intravenous patient controlled analgesia with different infusion modes after laparoscopic radical surgery of cervical cancer a prospective, randomized, double-blind study[J]．Medicine (Baltimore) . 2019 Aug;98(34): e16810-17.
21. Hao C, Xu H, Du J, Zhang T, et al．Impact of opioid-free anesthesia on postoperative quality of recovery in patients after laparoscopic cholecystectomy[J]．Drug Des Devel Ther. 2023 Nov 28;17:3539-47.
22. Li Y, Dou Z, Yang L, et al．Oxycodone versus other opioid analgesics after laparoscopic surgery: a meta-analysis[J]．Eur J Med Res. 2021 Jan 9;26(1):4-15.
23. Chhabra A, Singh S, Kaur S, et al．Quality of recovery (QoR-15) following opioid-free versus opioid anaesthesia for elective endoscopic nasal surgeries: A randomised, open-label comparative trial[J]．Indian J Anaesth . 2025 May;69(5):465-70．
24. Julia Riley,Elon Eisenberg,Gerhard Müller-Schwefe．et al．Oxycodone: a review of its use in the management of pain[J]．Curr Med Res Opin. 2008．24(1)．175-92．
25. Yao X, Wang Z, Zhang Y, et al．Oxycodone versus Sufentanil for Postoperative Recovery in Obese Patients Undergoing Laparoscopic Bariatric Surgery: A Randomized Controlled Trial [J]．Drug Des Devel Ther. 2025 Oct 17;19:9387-97．
26. Milton Raff,Anissa Belbachir,Salah El-Tallawy．et al．Intravenous oxycodone versus other intravenous strong opioids for acute postoperative pain control: A systematic review and meta-analysis[J]．Pain Ther . 2019 Jun;8(1):19-39.
27. Fassoulaki A, Sarantopoulos C, Zotou M, et al．Preemptive opioid analgesia does not influence pain after abdominal hysterectomy[J]．Can J Anaesth. 1995 Feb;42(2):109-13．
28. Menglu Jiang,Jiawei Ji,Xin Li,et al．Effect of intravenous oxycodone on the physiologic responses to extubation following general anesthesia[J]．BMC Anesthesiol . 2021 May 12;21(1):146-51．
29. Li S, Zhou M, Xia Y, et al. Preemptive oxycodone is superior to equal dose of sufentanil to reduce visceral pain and inflammatory markers after surgery: a randomized controlled trial. BMC Anesthesiol. 2019;19(1):96.

30. Hong-Yang Chen, Zi-Ning Wang, Wei-Yi Zhang,et al. Advances in the clinical application of oxycodone in the perioperative period. Front Pharmacol. 2022;13:921087.

Tables

Tables are available in the Supplementary Files section.

Figures

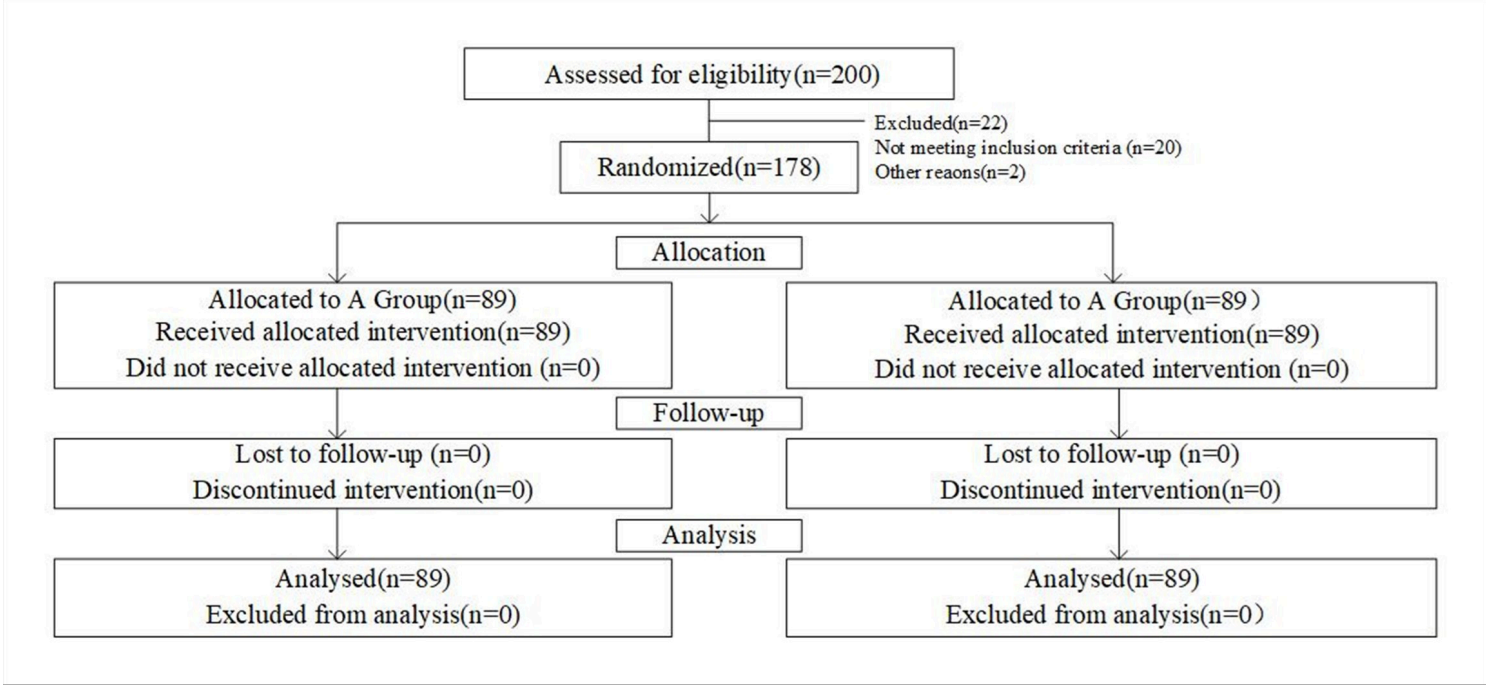


Figure 1

CONSORT flow diagram showing patient screening, randomization, and analysis.

Abbreviations: A group, oxycodone 0.1 mg/kg was injected intravenously at 10 minutes before induction.B group,oxycodone 0.1 mg/kg was injected intravenously at 10 minutes before the end of surgery (immediately at skin closure).

Supplementary Files

This is a list of supplementary files associated with this preprint. Click to download.

- Tables.docx