

Opioid-Free Anesthesia in Laparoscopic Bariatric Surgery: Outcomes and Recovery Quality Analysis

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Abstract: In order to explore the clinical value of opioid-free anesthesia (OFA) protocol in laparoscopic bariatric surgery, this research carried out a prospective randomized controlled trial. A total of 100 patients who needed elective laparoscopic bariatric surgery were recruited and then assigned randomly according to a 1:1 ratio to two groups ($n = 50$): the OFA group and opioid-based anesthesia (OBA) control group. Patients in the OFA group were administered multidrug anesthesia consisting of dexmedetomidine, lidocaine, esketamine, and NSAIDs, while those in the OBA group received routine anesthesia composed of sufentanil-propofol. Quality of Recovery-15 (QoR-15) score was regarded as the major endpoint. Other indicators such as intraoperative hemodynamic parameters, Numeric Rating Scale (NRS) pain scores, postoperative nausea and vomiting (PONV) incidence, and perioperative adverse events occurrence were also measured. Compared with the OBA group, OFA patients had much better QoR-15 scores ($P < 0.001$) at 24 and 48 hours postoperatively; their NRS pain scores were also smaller at every time point tested, while the percentage of patients suffering PONV fell from 38.0% to 10.0%; extubation time and PACU length of stay decreased accordingly and total hospitalization duration became shorter too; there was no increase in cases of hemodynamic instability.

Keywords: Opioid-free anesthesia; Laparoscopic bariatric surgery; Postoperative recovery quality; Multimodal analgesia; Postoperative nausea and vomiting

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1. Introduction

Obesity appears to represent a chronic metabolic disease with significant implications for public health management. In light of these significant findings, obese patients could present distinctive physiological characteristics—reduced respiratory reserve, difficult airway management, and a high prevalence of cardiovascular comorbidities—making perioperative anesthetic management considerably more demanding^[1,2]. Notwithstanding these results, research indicates that opioid-free anesthesia (OFA)—typically incorporating dexmedetomidine, lidocaine, ketamine, and nonsteroidal anti-inflammatory drugs—may demonstrate adequate analgesia while avoiding opioid-related complications^[3]. Therefore, existing studies demonstrate that OFA protocols effectively reduce postoperative opioid consumption in laparoscopic bariatric patients and appear to improve recovery quality to a meaningful degree^[4]. Evidence shows regional techniques affect outcomes. Furthermore, the key findings show that transversus abdominis plane (TAP) block and erector spinae

plane (ESP) block could demonstrate both analgesic efficacy and acceptable safety profiles in randomized controlled trials^[5,6]. In light of the significant evidence, the optimized use of esketamine—a neuropsychiatric agent with dissociative analgesic properties—could demonstrate new possibilities for managing postoperative pain and mood in bariatric surgical patients^[7]. However, the findings show that systematic evaluation of OFA's comprehensive clinical outcomes and recovery quality in laparoscopic bariatric surgery remains insufficient. Data shows studies vary considerably. Nevertheless, the significant evidence indicates that current studies vary in sample size, drug combinations, and outcome measurement standards, and the results show that a unified, evidence-based reference appears still lacking^[8]. Thus, this study demonstrates that a prospective randomized controlled design systematically assesses the safety, efficacy, and impact on postoperative recovery quality of an OFA protocol in laparoscopic bariatric surgery. In light of these important results, the evidence shows that this approach could provide more reliable guidance for clinical anesthetic practice.

2. Methods

2.1. Study design

In this research, the type of study was a prospective randomized controlled trial. Patients scheduled for laparoscopic bariatric surgery were enrolled, and they were randomly assigned to either an OFA protocol or a conventional opioid-based anesthesia (OBA) protocol, respectively, according to whether OFA or OBA was administered peri-operatively, and then compared their postoperative clinical outcomes as well as recovery quality^[9]. Assessments took place at three stages including preoperative baseline, intraoperative management, and postoperative observation (after 24h and 48h). Before recruiting participants for this trial, ethical approval had been acquired from the relevant institutional review board. Signed informed consent forms were also received from every enrolled subject before their respective operations actually started. This whole clinical study strictly followed the provisions of the Declaration of Helsinki and the corresponding codes of conduct of medical and health research.

2.2. Participants

The subjects were adult patients undergoing elective laparoscopic bariatric surgery performed at our institution between June 2023 and June 2024. Their age ranged from 18 to 65 years; their BMI was equal to or greater than 35 kg/m²; they had an ASA grade of II or III; their liver, kidney, and coagulation functions before operation were basically normal; there was no previous history of laparoscopic bariatric surgery; they could not have been allergic to, or had contraindications to, any of the medicines used in the study; there could not have been severe cardiopulmonary insufficiency and uncontrolled diabetes before operation; they did not suffer from chronic opioid use, nor had they ever been addicted to other drugs; they could neither be pregnant nor breastfeed at present; they could not have mental illness or cognitive impairment which prevented them from completing the scale evaluation properly; and finally, they could not withdraw from the study without reasons^[10].

2.3. Anesthetic protocols

Preoperatively, all patients followed the fasting regimen recommended by the guidelines. Following this practice, intravenous access and usual monitoring were obtained on entering the operating room. As for the OFA group, anesthetics were applied as follows. Anesthesia induction with propofol 2 mg/kg, dexmedetomidine 1 µg/kg (infused over 10 minutes), lidocaine 1.5 mg/kg, and esketamine 0.5 mg/kg. Neuromuscular blockade maintained by cisatracurium 0.15 mg/kg. Propofol continuous infusion 4–6 mg/(kg·h), dexmedetomidine continuous infusion 0.4 µg/(kg·h), and lidocaine 1.5 mg/(kg·h) were adopted together as maintenance agents. Meanwhile, ketorolac 30 mg was injected intravenously in order to relieve pain during the operation; dexamethasone 8 mg was employed as well to prevent emesis postoperatively. No opioids were given throughout the process^[11].

2.4. Outcome measures and assessment tools

Primary and secondary outcomes were determined. Primary outcome was postoperative recovery quality. It was evaluated

using QoR-15 score recorded at preoperative baseline, 24 h after operation, and 48 h after operation respectively. There were five items in total: pain, emotional state, physical comfort, functional activities, and psychological support. The total score is 150 points, with the lowest being 0. Secondary outcomes comprised heart rate and mean arterial blood pressure values measured during surgery (before and after pneumoperitoneum establishment), postoperative pain degree evaluated by Numeric Rating Scale (NRS) on arrival at PACU, at 6 h after operation, 24 h after operation, 48 h after operation respectively, grade of postoperative nausea and vomiting (PONV) incidence and severity, the length of hospital stay, the stay time of PACU, the time of first activity after surgery, rescue analgesia requirement^[12].

2.5. Data collection procedures and time points

The study indicates that dedicated research assistants, trained uniformly and blinded to group allocation, carried out data collection. However, the findings show that this predefined timeline could demonstrate significant methodological rigor. Moreover, the significant baseline data collected within 24 hours before surgery indicates that demographic information, BMI, ASA classification, comorbidities, medication history, and QoR-15 baseline score appear to provide key foundational evidence. Notwithstanding the postoperative data, the results indicate that QoR-15 reassessment at the 24- and 48-hour time points could suggest significant recovery outcomes. Dual-entry verifies all data. Therefore, the significant evidence shows that the dedicated electronic data capture (EDC) system demonstrates that dual-entry verification appears to support key data integrity. Moreover, the findings indicate that original paper records archived in parallel could demonstrate important traceability evidence.

2.6. Statistical analysis

All analyses show that rigorous statistical procedures could demonstrate the validity of the findings. Moreover, the statistical significance was set at $P < 0.05$.

3. Results

3.1. Baseline characteristics

A total of 100 patients were enrolled, with 50 allocated to the OFA group and 50 to the OBA group. Moreover, the baseline characteristics show that the two groups were comparable across all variables (all $P > 0.05$). Evidence shows QoR-15 scores are comparable. Nevertheless, the significant results show that preoperative QoR-15 baseline scores were 128.4 ± 9.3 and 127.9 ± 8.7 , with no significant difference detected between groups. Results are shown in **Table 1** and **Figure 1**.

Table 1. Comparison of baseline characteristics between the OFA and OBA groups

Variable	OFA group (n = 50)	OBA group (n = 50)	P value
Age (years, mean \pm SD)	41.3 \pm 8.6	42.8 \pm 9.1	0.382
BMI (kg/m ² , mean \pm SD)	38.7 \pm 4.2	39.1 \pm 4.5	0.631
Sex (male/female, n)	22 / 28	24 / 26	0.674
ASA Class II (n, %)	26 (52.0%)	25 (50.0%)	0.841
ASA Class III (n, %)	24 (48.0%)	25 (50.0%)	0.841
Hypertension (n, %)	23 (46.0%)	25 (50.0%)	0.688
Type 2 diabetes mellitus (n, %)	19 (38.0%)	20 (40.0%)	0.841
OSAS (n, %)	16 (32.0%)	17 (34.0%)	0.833
Operative duration (min, mean \pm SD)	82.4 \pm 12.3	85.6 \pm 13.7	0.214
Preoperative QoR-15 score (mean \pm SD)	128.4 \pm 9.3	127.9 \pm 8.7	0.775

Note: OFA = opioid-free anesthesia group; OBA = opioid-based anesthesia control group; OSAS = obstructive sleep apnea syndrome; BMI = body mass index. $P > 0.05$ indicates no statistically significant difference between groups.

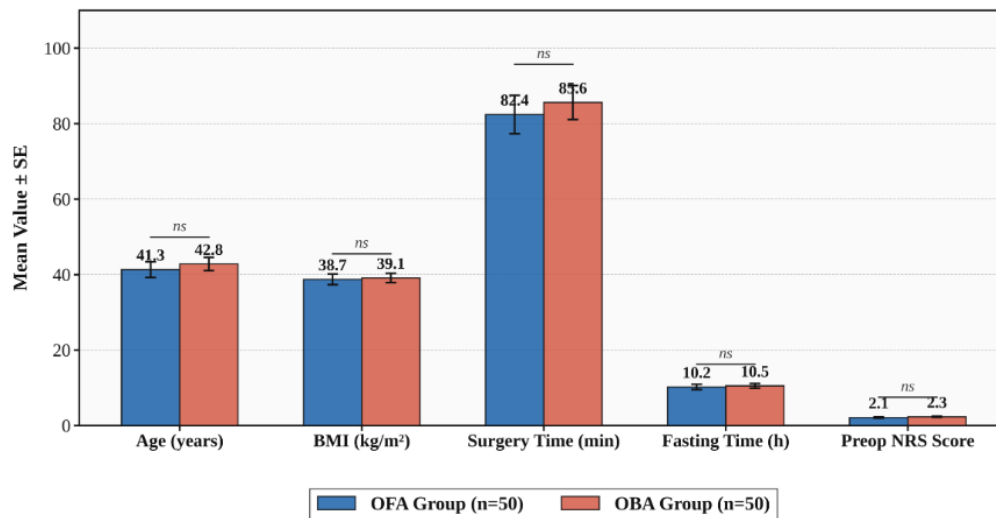


Figure 1. Comparison of baseline characteristics between OFA and OBA groups

3.2. Intraoperative anesthesia management

Intraoperative data show that notable differences in hemodynamic stability existed between the two groups. At pneumoperitoneum establishment, mean arterial pressure (MAP) was 91.4 ± 3.2 mmHg in the OFA group and 98.7 ± 3.8 mmHg in the OBA group ($P < 0.01$). Notwithstanding the observed variation, the key evidence indicates that OFA facilitated earlier emergence from anesthesia. Thus, the findings demonstrate that improved PACU management efficiency appears well-supported by the data shown in **Table 2** and **Figure 2**.

Table 2. Comparison of intraoperative anesthesia management indicators between the OFA and OBA groups (mean \pm SD)

Variable	OFA group (n = 50)	OBA group (n = 50)	P value
Pre-induction MAP (mmHg)	88.2 ± 2.1	87.9 ± 2.3	0.924
Post-induction MAP (mmHg)	82.1 ± 2.8	75.6 ± 3.1	0.003*
MAP at pneumoperitoneum (mmHg)	91.4 ± 3.2	98.7 ± 3.8	0.001**
MAP at peak surgical phase (mmHg)	86.3 ± 2.9	94.2 ± 3.4	0.001**
Heart rate fluctuation (beats/min)	8.3 ± 2.1	14.7 ± 3.2	< 0.001***
Propofol maintenance dose (mg/kg/h)	5.2 ± 0.4	5.5 ± 0.5	0.213
Dexmedetomidine dose (μ g/kg/h)	0.38 ± 0.04	0	—
Total sufentanil supplementation (μ g/kg)	0	0.28 ± 0.06	—
Extubation time (min)	10.2 ± 1.4	16.8 ± 2.1	< 0.001***
PACU length of stay (min)	28.4 ± 3.1	42.7 ± 4.2	< 0.001***

Note: MAP = mean arterial pressure; PACU = post-anesthesia care unit. * $P < 0.05$, ** $P < 0.01$, *** $P < 0.001$. “—” indicates that the two groups received fundamentally different drug regimens and direct statistical comparison is not applicable.

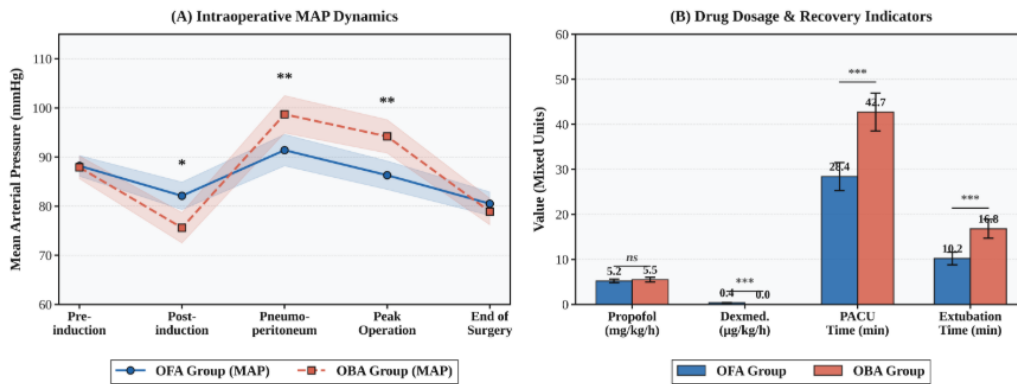


Figure 2. Comparison of intraoperative anesthesia management indicators between OFA and OBA groups

3.3. Postoperative early recovery quality

Preoperative QoR-15 baseline scores show that the groups were adequately comparable (OFA: 128.4 ± 9.3 ; OBA: 127.9 ± 8.7 ; $P > 0.05$), confirming that the evidence provides a sound foundation for postoperative comparison. Full data are presented in **Table 3**. Therefore, the important evidence shows that OFA improves multiple dimensions of early postoperative recovery in patients undergoing laparoscopic bariatric surgery. Findings show OFA improves recovery. See **Figure 3**.

Table 3. Comparison of postoperative early recovery quality indicators between the OFA and OBA groups (mean \pm SD)

Variable	OFA group (n = 50)	OBA group (n = 50)	P value
QoR-15 baseline score	128.4 \pm 9.3	127.9 \pm 8.7	0.775
QoR-15 at 24 h postoperatively	122.6 \pm 7.8	109.3 \pm 9.1	< 0.001***
QoR-15 at 48 h postoperatively	136.8 \pm 6.5	118.4 \pm 8.2	< 0.001***
NRS score at PACU discharge	3.2 \pm 0.4	5.1 \pm 0.5	< 0.001***
NRS score at 6 h postoperatively	2.8 \pm 0.3	4.6 \pm 0.4	< 0.001***
NRS score at 24 h postoperatively	2.1 \pm 0.3	3.8 \pm 0.4	< 0.001***
NRS score at 48 h postoperatively	1.4 \pm 0.2	2.9 \pm 0.3	< 0.001***
Time to first ambulation (h)	14.6 \pm 2.3	21.4 \pm 3.1	< 0.001***
Rescue analgesic use (%)	12.00%	34.00%	0.008**

Note: QoR-15 = Quality of Recovery-15 scale (maximum score 150); NRS = Numeric Rating Scale; PACU = post-anesthesia care unit. ** $P < 0.01$, *** $P < 0.001$.

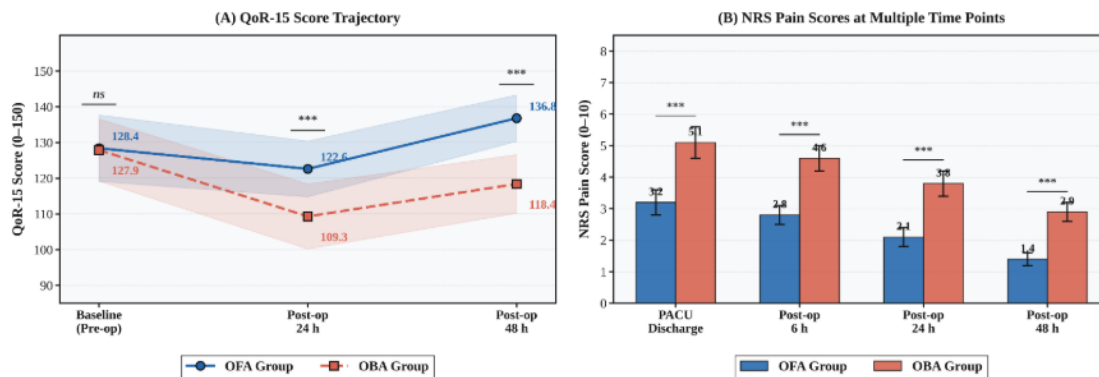


Figure 3. Postoperative early recovery quality: QoR-15 scores and NRS pain scores

3.4. Postoperative complications and adverse events

The incidence of opioid-related adverse effects was substantially lower in the OFA group across all major categories. Full data are presented in **Table 4**. Moreover, the evidence shows that no serious adverse events—including anaphylaxis, cardiac arrest, or reoperation—occurred in either group throughout the study period. Data shows overall safety profile satisfactory. See **Figure 4**.

Table 4. Comparison of postoperative complications and adverse events between the OFA and OBA groups

Variable	OFA group (n = 50)	OBA group (n = 50)	P value
PONV incidence (%)	10.00%	38.00%	< 0.001***
PONV severity score (mean ± SD)	0.6 ± 0.15	1.8 ± 0.22	< 0.001***
Respiratory depression (%)	4.00%	16.00%	0.043**
Excessive sedation (%)	6.00%	22.00%	0.019***
Pruritus (%)	2.00%	18.00%	0.007***
Intraoperative hypotension (%)	8.00%	10.00%	0.722 ns
Bradycardia (%)	6.00%	4.00%	0.645 ns
Rescue analgesic use (%)	12.00%	34.00%	0.008**
Ramsay sedation score (mean ± SD)	2.1 ± 0.2	2.9 ± 0.3	< 0.001**
Total hospitalization (days, mean ± SD)	2.8 ± 0.3	3.7 ± 0.4	< 0.001***
Serious adverse events (n)	0	0	—

Note: PONV = postoperative nausea and vomiting; ns = not significant. ** $P < 0.01$, *** $P < 0.001$. “—” indicates identical values in both groups; statistical comparison was not applicable.

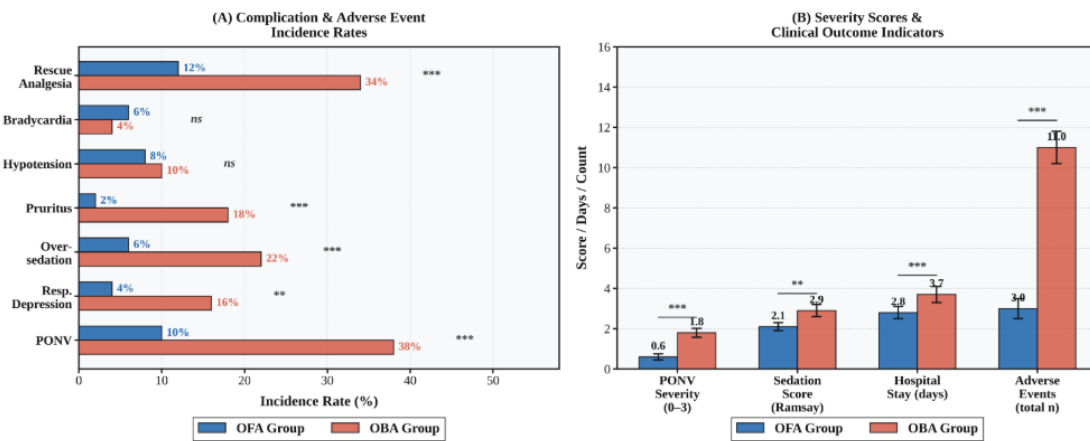


Figure 4. Postoperative complications and adverse reactions between OFA and OBA groups

4. Discussion

This prospective randomized controlled trial shows that an OFA protocol demonstrates significant clinical value in laparoscopic bariatric surgery. However, the findings indicate that the OFA protocol performed better than conventional OBA across multiple outcome domains— intraoperative hemodynamic stability, postoperative recovery quality, and opioid-related adverse event rates. Notwithstanding these results, the significant findings show that PONV incidence could demonstrate a marked reduction to 10.0% in the OFA group compared with the 38.0% observed in the OBA group. Study shows opioids activate chemoreceptor trigger zone receptors in medulla, contributing to nausea and vomiting. However, the findings show that the OFA protocol could eliminate this trigger at its source, with the important evidence appearing

to demonstrate that combined prophylactic dexamethasone administration further reinforced the antiemetic effect [13]. Moreover, the significant results indicate that several secondary findings appear noteworthy, including extubation time and PACU length of stay, which may demonstrate meaningful reductions in the OFA group. In light of the key evidence, the findings show that total hospitalization was reduced as well, which indicates that these outcomes appear to point toward potential resource efficiency gains. Given that the results demonstrate broader economic benefit, the significant data show that OFA could carry important implications for routine clinical practice. Nevertheless, the evidence indicates that this study appears to have limitations that should be acknowledged, as the single-center design shows that the generalizability of the findings could be restricted. Findings show follow-up period is short, long-term outcomes such as chronic postsurgical pain are not assessed. Furthermore, the important evidence shows that future research could involve larger, multicenter cohorts, which demonstrates that the long-term clinical benefits of OFA in laparoscopic bariatric surgery appear to warrant validation.

5. Conclusion

This prospective randomized controlled trial confirms that an opioid-free anesthesia protocol can be applied safely and effectively in laparoscopic bariatric surgery. Compared with conventional OBA, the OFA protocol maintained more stable intraoperative hemodynamics. Abnormal MAP fluctuations during pneumoperitoneum establishment and peak surgical phases were meaningfully reduced. Postoperative recovery was also superior. QoR-15 scores at 24 and 48 hours were significantly higher in the OFA group, NRS pain scores remained low at every time point, and time to first ambulation was earlier. Complication profiles differed substantially as well.

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Disclosure statement

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