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Perioperative Dexmedetomidine and Ketamine Infusions for Multimodal Analgesia Following Bariatric Surgery: A Randomized Double-Blind Placebo-Controlled Trial

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Abstract

Background

Effective postoperative pain control after bariatric surgery is challenging due to high opioid requirements and associated adverse effects. Dexmedetomidine and ketamine are widely used as adjuncts in multimodal analgesia; however, their comparative efficacy remains unclear. This study aimed to compare perioperative dexmedetomidine and ketamine infusions on postoperative analgesia and recovery outcomes following bariatric surgery.

Methods

Ninety-six patients undergoing elective bariatric surgery were randomly assigned to dexmedetomidine, ketamine, or placebo groups (n = 32 each). Dexmedetomidine was administered as a 0.5 μg/kg loading dose followed by 0.3 μg/kg/h infusion, and ketamine as a 0.5 mg/kg loading dose followed by 0.25 mg/kg/h infusion; placebo received normal saline. Infusions were discontinued 10 minutes before the end of surgery. Anesthetic management was standardized across groups. The primary outcome was postoperative pain intensity measured using the Numeric Rating Scale (NRS) in the post-anesthesia care unit (PACU) and at 30, 60, and 120 minutes. Secondary outcomes included 24-hour opioid consumption, sedation level, postoperative nausea and vomiting (PONV), patient satisfaction, and adverse events.

Results

Baseline characteristics were comparable among groups ($P > 0.05$). Dexmedetomidine significantly reduced postoperative pain scores at all time points compared with ketamine and placebo ($P < 0.001$). Ketamine showed only transient analgesic effects at 30 and 60 minutes. Opioid consumption was significantly lower in the dexmedetomidine group compared with ketamine and placebo ($P < 0.001$), while no significant difference was observed between ketamine and placebo ($P = 0.105$). Patient satisfaction was significantly higher in the dexmedetomidine group ($P < 0.001$). Sedation was higher early postoperatively with dexmedetomidine but normalized within 2 hours. No significant differences were observed in PONV or adverse events among groups.

Conclusion

Dexmedetomidine provides superior and sustained postoperative analgesia and reduces opioid consumption compared with ketamine and placebo in bariatric surgery, with acceptable safety. Ketamine offers only short-term analgesic benefit without meaningful opioid-sparing effects.

Trial Registration

Iranian Registry of Clinical Trials (IRCT): IRCT20230518058225N8, registered on January 6, 2025.

Introduction

Obesity has emerged as one of the most significant global health challenges of the twenty-first century, with its prevalence increasing steadily worldwide. Obesity is associated with substantial morbidity and mortality through its contribution to cardiovascular diseases, type 2 diabetes mellitus, obstructive sleep apnea, several malignancies, and reduced quality of life (1). For patients with severe obesity, bariatric surgery is currently recognized as the most effective long-term treatment strategy, resulting in sustained weight loss and significant improvement in obesity-related comorbidities(2, 3) .Consequently, the number of bariatric procedures performed worldwide has increased considerably over the last decade (3).

Despite advances in minimally invasive surgical techniques, postoperative pain remains a major concern following bariatric surgery. Inadequately controlled pain may delay ambulation, impair pulmonary function, prolong hospital stay, reduce patient satisfaction, and increase the risk of chronic postsurgical pain(4) .Effective postoperative analgesia is particularly important in bariatric patients because obesity-related respiratory disorders, including obstructive sleep apnea and obesity hypoventilation syndrome, increase susceptibility to opioid-induced respiratory depression and other opioid-related adverse events (4, 5).

Current Enhanced Recovery After Surgery (ERAS) guidelines advocate the use of multimodal analgesic strategies to improve pain control while minimizing perioperative opioid consumption(5).Multimodal analgesia combines analgesics with different mechanisms of action to enhance pain relief and reduce opioid-related complications, including respiratory depression, postoperative nausea and vomiting (PONV), sedation, and delayed recovery (4, 5). Therefore, identifying effective opioid-sparing analgesic agents remains an important objective in bariatric anesthesia.

Dexmedetomidine, a highly selective α2-adrenergic receptor agonist, has attracted considerable interest as a component of multimodal analgesia. In addition to its sedative and sympatholytic properties, dexmedetomidine has been shown to reduce perioperative opioid requirements and improve postoperative analgesia (6, 7). Recent evidence from systematic reviews and meta-analyses suggests that perioperative dexmedetomidine administration in bariatric surgery may decrease postoperative pain intensity, opioid consumption, and the incidence of PONV while facilitating postoperative recovery (6, 8).

Ketamine, a noncompetitive N-methyl-D-aspartate (NMDA) receptor antagonist, is another promising opioid-sparing analgesic. At subanesthetic doses, ketamine effectively attenuates central sensitization, reduces postoperative pain, and lowers opioid requirements without causing significant respiratory depression (9, 10). A recent systematic review and meta-analysis focusing on bariatric surgery demonstrated that perioperative ketamine administration significantly improved postoperative analgesia and reduced opioid consumption compared with conventional analgesic regimens (9).

Although both dexmedetomidine and ketamine have demonstrated beneficial effects as components of multimodal analgesia, direct comparisons between these agents in bariatric surgery remain limited. Most published studies have evaluated either dexmedetomidine or ketamine separately against placebo or standard analgesic protocols(6, 8, 9) .Furthermore, evidence regarding their comparative effects on

postoperative pain, opioid consumption, sedation, PONV, and overall recovery profile remains insufficient. A recent randomized controlled trial comparing ketamine and dexmedetomidine during laparoscopic sleeve gastrectomy reported favorable analgesic outcomes with both agents; however, further studies are required to establish their relative efficacy and safety across broader bariatric populations(11).

Therefore, the present study was designed to evaluate and compare the effects of perioperative dexmedetomidine and ketamine infusions on multimodal analgesia and postoperative recovery profile in patients undergoing bariatric surgery. We hypothesized that both agents would provide superior postoperative analgesia and reduced opioid requirements compared with placebo, while exhibiting distinct effects on sedation, PONV, and patient satisfaction.

Methods

Study Design and Ethical Considerations

This prospective randomized double-blind placebo-controlled clinical trial was conducted at Firoozgar Hospital, a tertiary referral center affiliated with Iran University of Medical Sciences, Tehran, Iran, between 2024 and 2025. The study protocol was approved by the Ethics Committee of Iran University of Medical Sciences (Approval No. IR.IUMS.FMD.REC.1403.319) and was registered in the Iranian Registry of Clinical Trials (IRCT No. IRCT20230518058225N8). The study was performed in accordance with the Declaration of Helsinki. Written informed consent was obtained from all participants prior to enrollment.

The trial was designed, conducted, and reported in accordance with the Consolidated Standards of Reporting Trials (CONSORT) 2010 Statement

Participants

Patients aged 18–60 years with a body mass index (BMI) > 35 kg/m², American Society of Anesthesiologists (ASA) physical status I–III, and scheduled for elective bariatric surgery, including sleeve gastrectomy, mini-gastric bypass, or Roux-en-Y gastric bypass, were screened for eligibility.

The exclusion criteria were: (1) conversion of laparoscopic surgery to open surgery; (2) known hypersensitivity or contraindication to ketamine or dexmedetomidine; (3) history of substance abuse or chronic opioid consumption; (4) use of psychotropic medications; (5) history of psychiatric or neurological disorders; (6) uncontrolled hypertension (systolic blood pressure ≥ 140 mmHg or diastolic blood pressure ≥ 90 mmHg); and (7) occurrence of severe drug-related adverse events requiring discontinuation of the study infusion, including severe bradycardia, hypotension, tachycardia, or hypertension.

Randomization and Blinding

A total of 96 eligible patients were randomly allocated in a 1:1:1 ratio into three groups: dexmedetomidine group (D), ketamine group (K), and placebo group (P). Randomization was performed using a computer-generated block randomization sequence with variable block sizes.

Allocation concealment was ensured using sequentially numbered opaque sealed envelopes prepared by an investigator not involved in patient recruitment, anesthesia management, or outcome assessment.

The study was conducted in a double-blind manner. Patients, anesthesiologists responsible for intraoperative management, recovery room personnel, data collectors, and outcome assessors were blinded to group allocation. Study medications were prepared by an independent anesthesiologist who had no role in patient care or data collection. All study solutions were prepared in identical syringes and infusion pumps with the same volume and appearance.

Anesthetic Management and Interventions

Upon arrival in the operating room, standard monitoring including electrocardiography (ECG), noninvasive blood pressure (NIBP), pulse oximetry (SpO_2), end-tidal carbon dioxide ($ETCO_2$), and bispectral index (BIS) monitoring was established. Two peripheral intravenous catheters (20-gauge) were inserted, and patients received preoperative hydration with Ringer's solution (5 mL/kg).

All patients received intravenous fentanyl 3 μg/kg based on lean body mass (LBM) and midazolam 0.02 mg/kg based on total body weight (TBW) before induction of anesthesia.

Patients in the ketamine group received ketamine 0.5 mg/kg intravenously over 10 minutes followed by continuous infusion at 0.25 mg/kg/h. Patients in the dexmedetomidine group received dexmedetomidine 0.5 μg/kg intravenously over 10 minutes followed by continuous infusion at 0.3 μg/kg/h. Patients in the placebo group received an equivalent volume of normal saline administered according to the same schedule. Continuous infusions were maintained until 10 minutes before completion of surgery.

General anesthesia was induced using propofol 1.5 mg/kg based on ideal body weight (IBW) and cisatracurium 0.2 mg/kg based on TBW to facilitate tracheal intubation.

Anesthesia was maintained with sevoflurane at an end-tidal concentration adjusted to maintain BIS values between 40 and 60. Additional cisatracurium (0.02 mg/kg) was administered every 45 minutes. Supplemental fentanyl (50 μg) was administered in response to increases in heart rate or blood pressure exceeding 20% of baseline values.

In cases of mean arterial pressure reduction greater than 20% from baseline persisting for more than 5 minutes, sevoflurane concentration was reduced by 25%. If hypotension persisted, a rapid infusion of Ringer's solution (5 mL/kg IBW) was administered, followed by intravenous ephedrine in 5-mg increments if necessary. Bradycardia (heart rate < 60 beats/min) was treated with atropine 0.75 mg intravenously.

Intraoperative fluid administration was performed according to the 4-2-1 rule. Ten minutes before the end of surgery, study drug infusions were discontinued and all patients received intravenous paracetamol (Apotel®) 1 g.

Outcome Measures

Primary Outcome

The primary outcome was postoperative pain intensity assessed using the Numeric Rating Scale (NRS; 0 = no pain, 10 = worst imaginable pain) upon admission to the post-anesthesia care unit (PACU) and at 30, 60, and 120 minutes thereafter.

Secondary Outcomes

Secondary outcomes included:

1. Total postoperative opioid requirement during the first 24 hours after surgery.

2. Incidence of postoperative nausea and vomiting (PONV) during the first 24 hours.

3. Sedation level assessed using the Ramsay Sedation Scale at PACU admission and at 30, 60, and 120 minutes postoperatively.

4. Patient satisfaction with postoperative pain management evaluated 24 hours after surgery using a 5-point Likert scale.

5. Incidence of adverse events, including hypotension, hypertension, bradycardia, and tachycardia.

Rescue analgesia was provided when NRS exceeded 3 using intravenous pethidine 0.5 mg/kg based on lean body mass. The total administered dose was recorded for each patient.

Sample Size Calculation

The sample size was calculated to detect a moderate effect size (Cohen's d = 0.5) in postoperative pain intensity among the three study groups, with a two-sided significance level (α) of 0.05 and a statistical power of 80% (β = 0.20). Based on these assumptions, the required sample size was estimated to be approximately 31 participants per group. To compensate for potential dropouts and protocol deviations, 32 patients were enrolled in each group, resulting in a total sample size of 96 participants.

Statistical Analysis

Data were analyzed using SPSS software version 26 (IBM Corp., Armonk, NY, USA). Continuous variables were assessed for normality using the Kolmogorov–Smirnov test and are presented as mean ± standard deviation (SD) or median (interquartile range), as appropriate. Categorical variables are reported as frequencies and percentages.

Baseline demographic and clinical characteristics were compared using one-way analysis of variance (ANOVA) or the Kruskal–Wallis test for continuous variables and the chi-square test or Fisher's exact test for categorical variables.

Repeated measurements of postoperative pain and sedation scores were analyzed using repeated-measures ANOVA with Bonferroni post hoc correction. A two-sided P-value < 0.05 was considered statistically significant.

Results

A total of 96 patients were enrolled and randomly allocated into three equal groups: dexmedetomidine (Dex), ketamine (Ket), and placebo (Pla). Demographic characteristics are presented in Table 1. There were no statistically significant differences among the three groups regarding age, sex distribution, weight, and BMI (P > 0.05), indicating successful randomization and baseline comparability.

Table 1
Baseline demographic characteristics of the study population

Variable	Dexmedetomidine (n = 32)	Ketamine (n = 32)	Placebo (n = 32)	P-value
Age (years)	40.61 ± 11.87	40.78 ± 11.74	36.75 ± 12.97	0.328
Sex (F/M)	5 / 27	6 / 26	7 / 25	0.873
Weight (kg)	123.19 ± 20.22	123.21 ± 19.69	122.23 ± 28.84	0.981
BMI	44.55 ± 4.54	46.24 ± 6.47	45.20 ± 5.18	0.478

Clinical characteristics of the patients are summarized in Table 2. The duration of surgery and anesthesia were significantly different among the three groups (P < 0.001). The longest operative and anesthesia times were observed in the dexmedetomidine group compared with the ketamine and placebo groups.

Table 2
Clinical and intraoperative characteristics of patients

Variable	Dexmedetomidine	Ketamine	Placebo	P-value
ASA classification	Distribution reported in original table	Distribution reported	Distribution reported	0.015
Type of surgery	Sleeve / Mini bypass / Classic bypass	Same	Same	< 0.001
Duration of surgery (hours)	1.74 ± 0.37	1.46 ± 0.45	1.25 ± 0.38	< 0.001
Duration of anesthesia (hours)	2.26 ± 0.36	1.91 ± 0.57	1.76 ± 0.38	< 0.001

Pain intensity

Postoperative pain scores at all assessed time points (on arrival to recovery room, 30 min, 60 min, 120 min, and 24 h postoperatively) showed statistically significant differences among the three groups ($P < 0.001$) (Table 3).

Table 3
Postoperative pain scores at different time points

Time point	Dexmedetomidine	Ketamine	Placebo	P-value
Recovery room arrival	1.81 ± 1.38	4.71 ± 1.63	5.72 ± 2.25	< 0.001
30 minutes	2.29 ± 1.61	4.62 ± 1.36	6.27 ± 1.92	< 0.001
60 minutes	2.42 ± 1.34	4.58 ± 1.33	5.84 ± 1.82	< 0.001
120 minutes	2.45 ± 1.17	4.50 ± 1.29	5.21 ± 2.02	< 0.001
24 hours	2.16 ± 1.03	4.19 ± 1.44	4.06 ± 1.91	< 0.001

Pairwise comparisons (Table 4) demonstrated that the dexmedetomidine group consistently experienced significantly lower pain scores compared with both the ketamine and placebo groups at all time points ($P < 0.001$). In contrast, no statistically significant difference was observed between the ketamine and placebo groups at recovery arrival, 120 minutes, and 24 hours postoperatively ($P > 0.05$). However, at 30 and 60 minutes postoperatively, pain scores in the ketamine group were significantly lower than those in the placebo group ($P < 0.001$ and $P = 0.004$, respectively).

Table 4
Pairwise comparisons of postoperative pain scores

Time point	Significant comparisons
Recovery	Dex < Ket < Pla (P < 0.001); Ket vs Pla P = 0.067
30 min	Dex < Ket < Pla (P < 0.001 all)
60 min	Dex < Ket < Pla (P < 0.001; Ket vs Pla P = 0.004)
120 min	Dex < Ket < Pla (P < 0.001; Ket vs Pla P = 0.161)
24 h	Dex < Ket < Pla (P < 0.001; Ket vs Pla P = 0.935)

Sedation level

Sedation scores differed significantly among the three groups at recovery arrival, 30 minutes, and 60 minutes postoperatively (P < 0.001), whereas no significant differences were observed at 120 minutes and 24 hours (Table 5).

Table 5
Postoperative sedation scores

Time point	Dexmedetomidine	Ketamine	Placebo	P-value
Recovery	4.61 ± 1.62	3.46 ± 1.86	2.09 ± 1.51	< 0.001
30 minutes	3.77 ± 1.80	1.93 ± 1.66	1.48 ± 1.17	< 0.001
60 minutes	2.45 ± 1.80	1.09 ± 0.39	1.09 ± 0.39	< 0.001
120 minutes	1.06 ± 0.35	1.00 ± 0.00	1.00 ± 0.00	0.354
24 hours	1.00 ± 0.00	1.00 ± 0.00	1.03 ± 0.17	0.395

Pairwise analysis (Table 6) showed significantly higher sedation levels in the dexmedetomidine group compared with both ketamine and placebo at recovery arrival, 30 minutes, and 60 minutes postoperatively (P < 0.05 to P < 0.001). Ketamine also resulted in significantly greater sedation compared with placebo only at recovery arrival (P = 0.004), while no significant differences were observed at later time points.

Table 6
Pairwise comparisons of sedation scores

Time point	Significant findings
Recovery	Dex > Ket > Pla (P < 0.05)
30 min	Dex > Ket > Pla (Ket vs Pla not significant, P = 0.476)
60 min	Dex > Ket > Pla (Ket vs Pla not significant, P = 1.000)

Patient satisfaction

Patient satisfaction scores (Likert scale) are presented in Tables 7–9. Overall, satisfaction differed significantly among the three groups at all postoperative time points (P < 0.001).

Table 7
Distribution of patient satisfaction (Likert scale)

Time	Group	Distribution across scores (1–5)	P-value
All time points	Dex / Ket / Pla	See original dataset	< 0.001

Dexmedetomidine consistently achieved the highest satisfaction scores at all time points, significantly exceeding both ketamine and placebo groups (P < 0.001).

Table 8
Mean patient satisfaction scores

Time point	Dexmedetomidine	Ketamine	Placebo	P-value
Recovery	3.81 ± 1.27	2.91 ± 1.25	2.24 ± 1.29	< 0.001
30 min	4.00 ± 1.09	2.50 ± 1.16	1.39 ± 1.08	< 0.001
60 min	4.19 ± 1.11	2.41 ± 1.04	1.91 ± 0.95	< 0.001
120 min	4.13 ± 1.06	2.34 ± 0.90	2.03 ± 0.98	< 0.001
24 h	4.29 ± 0.82	2.16 ± 0.95	1.96 ± 1.04	< 0.001

No statistically significant differences were observed between ketamine and placebo at most time points (P > 0.05), except for minimal early differences at recovery admission.

Table 9
Pairwise comparisons of patient satisfaction

Time point	Findings
All time points	Dex > Ket > Pla (P < 0.001)
Ket vs Pla	(P > 0.05)

Opioid consumption

Opioid consumption within the first 24 postoperative hours was significantly lower in the dexmedetomidine group compared with the ketamine and placebo groups (P < 0.001) (Table 10).

Table 10
Postoperative opioid consumption within 24 hours

Opioid dose	Dexmedetomidine	Ketamine	Placebo	P-value
0 mg	27 (84.37%)	14 (43.75%)	9 (28.13%)	< 0.001
20 mg	5 (15.63%)	18 (56.25%)	22 (68.75%)	
40 mg	0	0	1 (3.12%)	

Only 15.63% of patients in the dexmedetomidine group required opioid administration, compared with 56.25% in the ketamine group and 71.87% in the placebo group. Overall opioid consumption remained significantly lower in the dexmedetomidine group compared with the other two groups ($P < 0.05$), while no significant difference was found between ketamine and placebo groups ($P = 0.105$) (Table 11).

Table 11
Pairwise comparison of opioid consumption

Comparison	P-value
Dex vs Ket	0.004
Dex vs Pla	< 0.001
Ket vs Pla	0.105

Postoperative nausea, vomiting, and adverse events

The incidence of postoperative nausea and vomiting did not differ significantly among the three groups ($P > 0.05$) (Table 12).

Table 12
Incidence of postoperative nausea and vomiting

Complication	Dex	Ket	Pla	P-value
Nausea	6 (28.13%)	9 (56.25%)	8 (34.38%)	0.147
Vomiting	4 (18.75%)	6 (28.13%)	7 (68.75%)	0.253

Similarly, no statistically significant differences were observed regarding hypotension, hypertension, or tachycardia between groups ($P > 0.05$) (Table 13), indicating comparable safety profiles across interventions.

Table 13
Hemodynamic and adverse events

Adverse event	Dex	Ket	Pla	P-value
Hypotension	4 (12.5%)	5 (15.63%)	2 (6.25%)	0.444
Hypertension	3 (9.38%)	2 (6.25%)	0	0.058
Tachycardia	2 (6.25%)	1 (3.12%)	0	0.364

Discussion

The present randomized double-blind placebo-controlled trial demonstrated that perioperative dexmedetomidine infusion significantly improves postoperative analgesia, reduces opioid consumption, and enhances patient satisfaction following bariatric surgery compared with ketamine and placebo. In contrast, ketamine provided only transient early analgesic benefit without sustained opioid-sparing effects. Both interventions showed comparable safety profiles to placebo.

Dexmedetomidine produced a consistent and sustained reduction in postoperative pain scores and significantly decreased opioid consumption, with only 15.6% of patients requiring opioids compared with 56.3% in the ketamine group and 71.9% in the placebo group. These findings are strongly supported by previous evidence. Blaudszun et al. (2012) demonstrated in a systematic review and meta-analysis that α2-agonists significantly reduce postoperative opioid requirements and pain intensity across multiple surgical settings, including abdominal surgery(12) .Similarly, Weerink et al.(2017) confirmed that dexmedetomidine has robust opioid-sparing effects and improves postoperative analgesia without respiratory depression(13).

The strong analgesic performance of dexmedetomidine in bariatric surgery may be explained by its central sympatholytic action, inhibition of locus coeruleus activity, and modulation of spinal nociceptive transmission. Bariatric surgery is associated with high visceral nociceptive input, which may further enhance the benefit of multimodal analgesia strategies such as α2-agonist infusion.

In contrast, ketamine demonstrated only short-term analgesic benefit (30–60 minutes postoperatively), with no sustained effect on pain scores or opioid consumption. This finding is partially consistent with Loftus et al.(2010), who reported that low-dose ketamine infusion reduces early postoperative pain but its effect is more pronounced in opioid-tolerant patients rather than opioid-naïve populations(14) .The transient nature of ketamine's effect in our study may be related to its short elimination half-life and the lack of prolonged NMDA receptor antagonism after discontinuation of infusion.

Dexmedetomidine consistently produced significantly lower pain scores across all postoperative time points, while ketamine showed only early improvement. These results align with Schnabel et al.(2013), who reported in a meta-analysis that dexmedetomidine provides more stable and prolonged analgesia compared with ketamine and placebo(15).

Conversely, Schwenk et al.(2018) demonstrated that perioperative ketamine infusion reduces postoperative pain and opioid consumption in major abdominal surgery(16) .The discrepancy with our findings may be due to differences in dosing strategies, duration of infusion, and patient population. In bariatric patients, altered pharmacokinetics due to obesity-related physiological changes may also reduce ketamine efficacy.

Dexmedetomidine was associated with significantly higher sedation levels in the early postoperative period, which normalized within 120 minutes. This is consistent with Herr et al.(2003), who described dexmedetomidine as producing cooperative sedation without respiratory depression, making it suitable for enhanced recovery pathways(17).

Ketamine produced minimal sedation, consistent with its dissociative mechanism that preserves airway reflexes and spontaneous respiration.

Patient satisfaction was significantly higher in the dexmedetomidine group at all time points. This finding is consistent with Liu et al.(2025), who reported improved patient satisfaction with dexmedetomidine-based analgesic protocols compared with opioid-based strategies in abdominal surgery(18) .The superior satisfaction likely reflects combined effects of improved analgesia and mild sedative comfort.

Ketamine did not significantly improve patient satisfaction compared with placebo, which may be due to its limited sustained analgesic benefit and potential for dysphoric or psychomimetic effects in some patients, even at low doses.

No significant differences were observed among groups in terms of postoperative nausea and vomiting or hemodynamic instability. These findings are consistent with Weerink et al.(2017), who reported that dexmedetomidine, when used in appropriate doses, does not significantly increase clinically relevant adverse hemodynamic effects(13) .Similarly, ketamine is known to maintain cardiovascular stability through sympathetic stimulation, which may explain the comparable safety profile.

Interestingly, surgical and anesthesia durations were longer in the dexmedetomidine group. Given successful randomization, this finding is likely incidental rather than drug-related. However, some studies suggest that dexmedetomidine may modestly affect intraoperative hemodynamics, potentially influencing surgical workflow consistency (13).

Overall, dexmedetomidine appears to be a superior adjunct for multimodal analgesia in bariatric surgery, offering sustained pain control, significant opioid reduction, and improved patient satisfaction. Ketamine may be better suited as an adjunct for early postoperative analgesia rather than a sole or primary infusion strategy.

This study has limitations, including its single-center design, lack of plasma drug level monitoring, and limited follow-up duration (24 hours). Additionally, intraoperative anesthetic depth and adjunct analgesic use were not fully standardized, which may influence outcomes.

Conclusion

Dexmedetomidine infusion provides superior and sustained multimodal analgesia compared with ketamine and placebo in bariatric surgery, significantly reducing postoperative pain scores and opioid consumption while improving patient satisfaction. Ketamine offers only transient analgesic benefits. Both agents demonstrated acceptable safety profiles, supporting dexmedetomidine as a preferred component of enhanced recovery analgesic protocols.

Abbreviations

ASA
American Society of Anesthesiologists
ANOVA
Analysis of Variance
ASA
American Society of Anesthesiologists
BIS
Bispectral Index
BMI
Body Mass Index
Dex
Dexmedetomidine Group
ECG
Electrocardiography
$ETCO_2$
End-Tidal Carbon Dioxide
IBW
Ideal Body Weight
IRCT
Iranian Registry of Clinical Trials
LBM
Lean Body Mass
NIBP
Noninvasive Blood Pressure
NMDA
N-Methyl-D-Aspartate
NRS
Numeric Rating Scale
PACU
Post-Anesthesia Care Unit
Pla

Placebo Group
PONV
Postoperative Nausea and Vomiting
SpO_2
Peripheral Oxygen Saturation
TBW
Total Body Weight

Declarations

Ethics approval and consent to participate

The study protocol was approved by the Ethics Committee of Iran University of Medical Sciences (Approval No. IR.IUMS.FMD.REC.1403.319). The trial was registered in the Iranian Registry of Clinical Trials (IRCT No. IRCT20230518058225N8). Written informed consent was obtained from all participants before enrollment.

Consent for publication

Not applicable.

Competing interests

The authors declare that they have no competing interests.

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Author Contribution

P.A: investigation, supervision. M.A investigation, methodology. N.N: writing – original draft, writing – review and editing. M.GH: project administration, writing – review and editing.

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Availability of data and materials

The datasets generated and/or analyzed during the current study are not publicly available because they contain potentially identifiable participant information and are subject to ethical restrictions. De-identified data are available from the corresponding author upon reasonable request and with permission from the Ethics Committee of Iran University of Medical Sciences.

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