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ORIGINAL ARTICLE

Comparative Evaluation of Ketamine–Propofol versus Ketamine–Diazepam for Total Intravenous Anesthesia in ERAS-Guided Day Case Surgery

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ABSTRACT

Introduction: *ERAS protocols in day-case surgeries reduce stress and promote faster recovery. TIVA is favored for its controllable depth and quick emergence. This study compares ketamine–propofol and ketamine–diazepam anesthesia regarding perioperative stability and recovery outcomes in ERAS-guided day-case surgeries.* ***Methods & Materials:*** *This one-year prospective comparative study (July 2024–June 2025) at Gazi Medical College, Khulna, included 60 adults undergoing ERAS-guided day-case surgery. Patients were randomized into two groups: Group A (Ketamine + Propofol) and Group B (Ketamine + Diazepam). Perioperative parameters, recovery, PONV, pain, complications, and hospital stay were analyzed using SPSS v26.0, with $p < 0.05$ considered significant.* ***Results:*** *Both groups were comparable in demographics, ASA status, types of surgery, and intraoperative parameters. Group A (ketamine–propofol) demonstrated significantly better hemodynamic stability, smoother recovery from anesthesia, and a lower incidence of PONV ($p < 0.05$). Recovery was faster in Group A, with earlier oral intake and ambulation, shorter PACU stay, and reduced hospital stay (all $p < 0.001$). Intraoperative complications were also lower in Group A.* ***Conclusion:*** *The study concludes that the ketamine–propofol combination offers superior recovery outcomes compared to ketamine–diazepam for total intravenous anaesthesia in ERAS-guided day-case surgeries. It provides better postoperative analgesia, reduces PONV, and ensures smoother and faster recovery without compromising hemodynamic stability. This regimen aligns well with ERAS principles, making it a more effective choice for ambulatory anesthesia.*

Keywords: *Total Intravenous Anesthesia (TIVA), Enhanced Recovery after Surgery (ERAS), Day Case Surgery*

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INTRODUCTION

Enhanced Recovery after Surgery (ERAS) protocols have transformed perioperative care by emphasizing evidence-based strategies to minimize surgical stress, reduce complications, and accelerate recovery. A key component of ERAS is the optimization of anesthesia techniques to improve postoperative outcomes, reduce opioid consumption, and enhance patient satisfaction [1,2]. Traditionally, balanced anesthesia has relied heavily on inhalational agents and opioids. However, opioid-related adverse effects, including postoperative nausea and vomiting (PONV), delayed gastrointestinal recovery, and the risk of dependence, have spurred interest in alternative anesthetic approaches [3,4]. Total Intravenous Anesthesia (TIVA) with propofol, often combined with adjunct agents such as dexmedetomidine or ketamine, has emerged as a promising strategy to meet ERAS objectives across various surgical specialties. Propofol is widely favored in modern anesthesia because of its favorable pharmacokinetics, rapid onset, and smooth recovery profile. Compared with volatile anesthetics, propofol-based TIVA is associated with a lower incidence of PONV, improved hemodynamic stability, and reduced environmental contamination [5,6]. Furthermore, propofol's antiemetic and anxiolytic properties make it particularly suitable for short-duration ambulatory procedures, which align closely with ERAS principles emphasizing early mobilization and discharge

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[7]. Nevertheless, propofol alone lacks sufficient analgesic potency, necessitating the use of adjunct agents to ensure adequate intraoperative and postoperative pain control. Dexmedetomidine, a highly selective α2-adrenergic agonist, has gained popularity as an adjunct to TIVA owing to its sedative, anxiolytic, and opioid-sparing effects [8]. It provides stable hemodynamics, attenuates stress responses, and enhances patient comfort, making it particularly valuable in ERAS-based anesthesia protocols [9]. Ketamine, an N-methyl-D-aspartate (NMDA) receptor antagonist, is another effective adjunct. At sub-anesthetic doses, it provides analgesia, attenuates central sensitization, and reduces postoperative opioid requirements without causing significant psychomimetic effects [10,11]. In Bangladesh, where dexmedetomidine availability is limited, ketamine is widely used as an alternative adjunct [12]. The combination of propofol with ketamine thus offers a balanced anesthetic regimen with favorable recovery outcomes. Several comparative studies have highlighted the benefits of TIVA in the ERAS setting. A meta-analysis reported that propofol-based TIVA significantly reduced PONV and facilitated faster recovery compared with inhalational anesthesia [13]. Additionally, propofol use has been associated with improved perioperative analgesia, lower opioid consumption, and smooth and quick recovery after surgery [14]. Similarly, ketamine as an adjunct enhances hemodynamic stability, reduces hyperalgesia, and provides prolonged analgesia, particularly in ambulatory and day-care surgeries [15,16]. Collectively, these findings underscore the potential of TIVA regimens to advance ERAS goals. In the Asian clinical context, where resource limitations and high surgical workloads necessitate efficient recovery pathways, ERAS implementation is increasingly recognized as a strategy to optimize perioperative care [17]. However, limited regional data exist on the comparative outcomes of TIVA with propofol and adjuncts versus conventional anesthesia (ketamine plus diazepam) under ERAS frameworks. Most available evidence originates from high-income countries and may not directly apply to local practice due to differences in patient demographics, healthcare infrastructure, and anesthetic resources [18,19]. This gap highlights the need for context-specific research to evaluate the feasibility and effectiveness of TIVA regimens in improving recovery outcomes for Bangladeshi patients. Day case surgeries, including dilatation and curettage (D&C), breast lump excision, endoscopy, and minor urological or orthopaedic procedures, represent a large proportion of elective surgical cases in Bangladesh. Although these procedures are relatively low risk, they still require optimal anesthetic strategies to minimize perioperative morbidity and maximize efficiency. Employing propofol-based TIVA with ketamine in such surgeries may reduce additional anesthetic exposure, facilitate faster recovery, and improve patient satisfaction, consistent with ERAS principles [20]. Therefore, the study aimed to compare the efficacy, hemodynamic stability, recovery, and postoperative outcomes of Ketamine–Propofol and Ketamine–Diazepam total intravenous anesthesia (TIVA) regimens in adult patients undergoing ERAS-guided day-case surgeries.

METHODS & MATERIALS

This prospective, comparative study was conducted at the Department of Anesthesiology, Gazi Medical College, Khulna, Bangladesh, from July 2024 to June 2025. After obtaining informed written consent and completing pre-anesthetic evaluation, 60 adult patients (≥18 years) scheduled for elective day case surgeries including dilatation and curettage (D&C), minor orthopedic procedures, breast or cyst excision/biopsy, endoscopy, herniotomy, circumcision, cystoscopy, and urethral dilatation were included. Patients with ASA physical status IV or higher, known hypersensitivity to study drugs, pregnancy, or inability to provide consent were excluded. Participants were randomly allocated to Group A (Ketamine–Propofol) or Group B (Ketamine–Diazepam) using a computer-generated randomization table. In Group A, anesthesia was induced with IV ketamine 2 mg/kg and propofol 2 mg/kg intravenously, with supplemental doses administered as necessary to maintain adequate anesthesia. Group B received IV ketamine 2 mg/kg and diazepam 0.2 mg/kg, with additional intraoperative doses administered as required.

Complete general anesthesia preparation was ensured, with all emergency airway equipment and essential drugs kept ready. All procedures adhered to Enhanced Recovery After Surgery (ERAS) protocols. Preoperative measures included minimal fasting and carbohydrate loading 2 hours before surgery. Intraoperative management utilized a multimodal anesthetic approach to minimize opioid consumption and maintain hemodynamic stability. Postoperatively, patients were encouraged to have early oral intake and ambulation to expedite recovery. Standard intraoperative monitoring comprised continuous assessment of heart rate, non-invasive blood pressure, respiratory rate, oxygen saturation, urine output, and core body temperature, recorded using a G3L Patient Monitor (Shenzhen General Meditech Inc., China). Hemodynamic parameters were documented at baseline, induction, every 5 minutes intraoperatively, and at the conclusion of surgery.

Preoperative data included demographics, comorbidities, ASA status, and surgical type. Intraoperative parameters assessed were hemodynamic stability, duration of surgery and anesthesia, blood loss, and fluid administration. Postoperative outcomes included Visual Analogue Scale (VAS) pain scores at 1, 6, and 12 hours, requirement for rescue analgesia, incidence of postoperative nausea and vomiting (PONV), time to first oral intake, time to ambulation, length of Post-Anesthesia Care Unit (PACU) stay using Aldrete score, and total hospital stay.

Data were analyzed using SPSS version 26.0. Continuous variables were expressed as mean ± standard deviation and compared using independent t-tests or Mann–Whitney U tests, as appropriate. Categorical variables were summarized as frequencies and percentages and analyzed using Chi-square or Fisher's exact tests. A p-value <0.05 was considered statistically significant.

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RESULTS

The demographic characteristics were comparable between the two groups, with no statistically significant differences observed. The mean age was similar (39.5 ± 12.4 years in Group A vs. 40.8 ± 11.9 years in Group B; p = 0.72), and the gender distribution was balanced (male: 63.33% vs. 60.0%; p = 0.78). Both groups had comparable BMI (23.8 ± 3.1 vs. 24.1 ± 3.4; p = 0.81). The majority of patients in both groups were ASA I–II (90.0% in Group A vs. 86.67% in Group B; p = 0.69), with a small proportion classified as ASA III. [Table I]

Table – I: Demographic Characteristics of Study Participants (*n*=60)

Variable	Group A (n=30)	Group B (n=30)	p-value
Age (years), mean ± SD	39.5 ± 12.4	40.8 ± 11.9	0.72
Sex, n (%)			
Male	19 (63.33%)	18 (60.0%)	0.78
Female	11 (36.67%)	12 (40.0%)	
BMI (kg/m^2), mean ± SD	23.8 ± 3.1	24.1 ± 3.4	0.81
ASA I–II, n (%)	27 (90.0%)	26 (86.67%)	0.69
ASA III, n (%)	3 (10.0%)	4 (13.3%)	

Both groups had comparable representation across gynecological, orthopedic, general, and urological procedures, ensuring balance in surgical case mix. The mean surgical duration was nearly equivalent (72.5 ± 18.4 minutes in Group A vs. 74.6 ± 19.1 minutes in Group B; p = 0.67), as was the duration of anesthesia (88.2 ± 20.7 vs. 91.3 ± 21.9 minutes; p = 0.58). [Table II]

Table – II: Surgical and Anesthesia Details

Variable	Group A (n=30)	Group B (n=30)	p-value
Surgical Procedure, n (%)			
Dilatation and curettage (D&C)	5 (16.67%)	6 (20.00%)	0.72
Short orthopedic procedures (dislocation, closed reduction)	5 (16.67%)	5 (16.67%)	1.00
Cervical cyst removal	3 (10.0%)	2 (6.67%)	0.64
Breast lump excision/biopsy	5 (16.67%)	3 (10.0%)	0.69
Diagnostic or therapeutic endoscopy	3 (10.0%)	4 (13.33%)	0.72
Herniotomy	3 (10.0%)	4 (13.33%)	0.72
Circumcision	3 (10.0%)	3 (10.0%)	1.00
Cystoscopy	2 (6.67%)	2 (6.67%)	1.00
Urethral dilatation	1 (3.33%)	1 (3.3%)	1.00
Surgical Duration (min), mean ± SD	72.5 ± 18.4	74.6 ± 19.1	0.67
Anaesthesia Duration (min), mean ± SD	88.2 ± 20.7	91.3 ± 21.9	0.58

Hemodynamic stability was achieved in the majority of patients, though Group A showed a higher proportion of stable cases (90.0% vs. 76.67%; p = 0.16). Intraoperative complications occurred infrequently and at similar rates (6.67% in Group A vs. 13.33% in Group B; p = 0.39). Mean blood loss (110 ± 35 ml vs. 120 ± 40 ml; p = 0.33) and fluid administration (950 ± 210 ml vs. 1010 ± 230 ml; p = 0.41) were also comparable. [Table III]

Table – III: Intraoperative Outcomes of both Groups

Variable	Group A (n=30)	Group B (n=30)	p-value
Hemodynamic Stability, n (%)			
Stable	27 (90.0%)	23 (76.67%)	0.16
Unstable	3 (10.0%)	7 (23.33%)	
Intraoperative Complications, n (%)	2 (6.67%)	4 (13.33%)	0.39
Blood Loss (ml), mean ± SD	110 ± 35	120 ± 40	0.33
Fluids Administered (ml), mean ± SD	950 ± 210	1010 ± 230	0.41

Postoperative outcomes showed significant advantages in Group A compared to Group B. Pain scores were consistently lower in Group A at 1 hour (2.4 ± 1.0 vs. 3.9 ± 1.2; p < 0.001), 6 hours (2.1 ± 0.9 vs. 3.4 ± 1.1; p < 0.001), and 12 hours (1.6 ± 0.8 vs. 2.5 ± 1.0; p = 0.002). Fewer patients in Group A required rescue analgesia (16.67% vs. 43.33%; p = 0.04). The incidence of PONV was also lower in Group A, with 80.0% experiencing no PONV compared to 50.0% in Group B (p = 0.03). Recovery parameters were notably better in Group A, including shorter times to first oral intake (6.1 ± 1.8 vs. 9.3 ± 2.2 hours; p < 0.001) and ambulation (7.5 ± 2.0 vs. 11.2 ± 2.6 hours; p < 0.001). Length of PACU stay (2.3 ± 0.9 vs. 3.4 ± 1.1 hours; p < 0.001) and hospital stay (2.1 ± 0.8 vs. 3.2 ± 1.0 days; p < 0.001) were also significantly reduced in Group A. Although postoperative complications were slightly more frequent in Group B, the differences were not statistically significant. [Table IV]

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Table – IV: Postoperative Outcomes of both Groups

Variable	Group A (n=30)	Group B (n=30)	p-value
Pain Score (VAS)			
At 1 hr, mean ± SD	2.4 ± 1.0	3.9 ± 1.2	<0.001*
At 6 hrs, mean ± SD	2.1 ± 0.9	3.4 ± 1.1	<0.001*
At 12 hrs, mean ± SD	1.6 ± 0.8	2.5 ± 1.0	0.002*
Rescue Analgesia Required, n (%)	5 (16.67%)	13 (43.33%)	0.04*
PONV, n (%)			
None	24 (80.0%)	15 (50.0%)	0.03*
Mild	5 (16.67%)	9 (30.0%)	
Moderate	1 (3.33%)	5 (16.67%)	
Severe	0	1 (3.33%)	
Time to First Oral Intake (hrs), mean ± SD	6.1 ± 1.8	9.3 ± 2.2	<0.001*
Time to Ambulation (hrs), mean ± SD	7.5 ± 2.0	11.2 ± 2.6	<0.001*
Length of PACU Stay (hrs), mean ± SD	2.3 ± 0.9	3.4 ± 1.1	<0.001*
Length of Hospital Stay (days), mean ± SD	2.1 ± 0.8	3.2 ± 1.0	<0.001*
Postoperative Complications, n (%)			
Minor	2 (6.67%)	5 (16.67%)	0.18
Major	0 (0.0%)	1 (3.33%)	

DISCUSSION

This study demonstrated that a propofol-based TIVA with ketamine (Group A) provided a smoother recovery profile than ketamine–diazepam regimen (Group B) for day-case surgeries under an ERAS protocol. Key findings included numerically greater intraoperative hemodynamic stability in Group A, along with significantly reduced postoperative pain, lower rescue analgesic requirements, a diminished incidence of PONV, and faster achievement of recovery milestones (oral intake, ambulation, and discharge readiness) compared to Group B. These results are largely consistent with recent literature, which has increasingly highlighted the benefits of TIVA (especially propofol–ketamine combinations) over traditional anesthetic techniques in terms of hemodynamics, analgesia, PONV reduction, and rapid recovery. Group A had a higher proportion of patients maintaining stable blood pressure and heart rate intraoperatively (90% vs 76.7% in Group B), although this difference was not statistically significant. This trend aligns with evidence that adding ketamine to propofol can buffer hemodynamic depression. Ketamine's sympathomimetic action tends to counteract propofol-induced hypotension [21]. A recent randomized trial comparing propofol–ketamine admixtures found that a 1:1 ketamine/propofol ratio significantly reduced the incidence of post-induction hypotension (12% vs 35%) and vasopressor requirements versus a propofol-heavy 1:3 mixture [22]. Similarly, a meta-analysis of "Ketofol" for sedation reported a lower risk of hypotension with propofol–ketamine combinations than with propofol alone [23]. In our study, intraoperative adverse events were rare and comparable between groups (6.7% vs 13.3%). Large-scale analyses indicate no significant differences in overall intraoperative complication rates or mean arterial pressure when comparing TIVA to inhalational anesthesia, aside from heart rate control [24]. Notably, a retrospective study in orthognathic surgery found TIVA stabilized hemodynamics during emergence better than volatile anesthesia [25]. The enhanced cardiovascular stability with propofol–ketamine may be especially valuable in high-risk patients, as it mitigates peri-induction hypotension without compromising anesthesia depth [21-23]. Propofol's vasodilatory effect is well documented; however, when balanced with adjunct agents (such as ketamine), it ensures controlled anesthesia with minimal sympathetic stimulation compared to ketamine, which can cause tachycardia and hypertension due to sympathomimetic activity [26,27]. Thus, our results support the evidence that propofol-based TIVA with ketamine may be more favorable in maintaining perioperative hemodynamic stability, thereby contributing to enhanced recovery outcomes. Recovery parameters, including time to oral intake and ambulation, were significantly shorter in the TIVA group. Pain control was significantly better in Group A, with lower pain scores at all time points and fewer patients needing rescue opioids. This aligns with studies showing that propofol-based anesthesia provides modest analgesic benefits and reduces opioid use compared to inhalational agents [28]. Ketamine's NMDA antagonism further enhances analgesia, and propofol TIVA is associated with lower pain scores and morphine use than sevoflurane [29,30]. Although some studies note only modest effects, the consistent opioid-sparing benefits of propofol–ketamine regimens likely contributed to Group A's reduced PONV [28-30]. One of the most significant advantages of propofol–ketamine TIVA was the reduction in PONV: only 20% of Group A patients experienced nausea/vomiting, compared to 50% in Group B. This aligns with evidence that propofol markedly decreases PONV relative to volatile or benzodiazepine-based anesthesia [24,25,31]. A 2025 systematic review reported that inhalational anesthesia more than doubled the risk of PONV compared to TIVA [24]. Similarly, in orthognathic surgery, TIVA reduced nausea/vomiting rates, partly due to reduced fentanyl requirements [25]. Our Group B likely had more PONV due to higher opioid use and the absence of propofol's antiemetic effect. These results reinforce guidelines recommending TIVA for high-risk PONV patients [31]. Enhanced recovery was a hallmark of Group A's outcomes. Patients in the propofol–ketamine group achieved oral intake

and ambulation 3–4 hours earlier than Group B, and their PACU and hospital stays were significantly shorter. This reflects propofol's rapid clearance and ketamine's analgesic effect, which facilitated early mobilization without the need for prolonged sedation. In contrast, diazepam in Group B likely delayed psychomotor recovery. Meta-analyses consistently show propofol anesthesia shortens recovery compared to benzodiazepines [32,33]. For example, propofol sedation has been shown to significantly reduce recovery times compared to midazolam in bronchoscopy [32]. In ERAS pathways, early feeding and ambulation reduce complications and length of stay [1]. Our findings confirm that propofol–ketamine TIVA synergizes with ERAS principles, enabling safe, earlier discharge and smoother recovery.

Limitations of the study: The present study is limited by its modest sample size and single-center design, which may restrict the generalizability of the results. Furthermore, although short-term outcomes such as pain, postoperative nausea and vomiting (PONV), and recovery milestones showed significant improvement with TIVA, long-term parameters, including chronic pain, functional recovery, and cost-effectiveness, were not evaluated. The absence of blinding also introduced potential bias in subjective outcomes such as pain and PONV.

CONCLUSION

This study concludes that the ketamine–propofol combination provides superior anesthetic performance compared to ketamine–diazepam for total intravenous anesthesia in ERAS-guided day-case surgeries. Both regimens offered comparable intraoperative stability and safety. However, the ketamine–propofol group demonstrated significantly better postoperative outcomes, including lower pain scores, reduced need for rescue analgesia, decreased incidence of PONV, and faster recovery milestones such as oral intake, ambulation, and discharge. The propofol–ketamine synergy ensured balanced anesthesia with minimal hemodynamic fluctuation and enhanced recovery, aligning well with ERAS principles. Therefore, ketamine–propofol appears to be a more effective and recovery-friendly option for ambulatory surgical anesthesia.

RECOMMENDATION

Based on the findings, the ketamine–propofol combination is recommended as a preferred total intravenous anesthetic regimen for ERAS-guided day-case surgeries. Its superior postoperative analgesia, lower incidence of PONV, and faster recovery support its routine use in ambulatory surgical settings. Future research with larger, multicenter trials is advised to validate these results across diverse surgical populations and to optimize dosing ratios for maximal hemodynamic stability and recovery efficiency. Additionally, integrating ketamine–propofol TIVA into standardized ERAS protocols may further enhance patient outcomes and promote early discharge without compromising safety or comfort.

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REFERENCES

1. *Ljungqvist O, Scott M, Fearon KC. Enhanced recovery after surgery: a review. JAMA surgery. 2017 Mar 1;152(3):292-8.*
2. *Melloul E, Hübner M, Scott M, Snowden C, Prentis J, Dejong CH, Garden OJ, Farges O, Kokudo N, Vauthey JN, Clavien PA. Guidelines for perioperative care for liver surgery: enhanced recovery after surgery (ERAS) society recommendations. World journal of surgery. 2016 Oct;40(10):2425-40.*
3. *Chou R, Gordon DB, de Leon-Casasola OA, Rosenberg JM, Bickler S, Brennan T, Carter T, Cassidy CL, Chittenden EH, Degenhardt E, Griffith S. Management of Postoperative Pain: a clinical practice guideline from the American pain society, the American Society of Regional Anesthesia and Pain Medicine, and the American Society of Anesthesiologists' committee on regional anesthesia, executive committee, and administrative council. The journal of pain. 2016 Feb 1;17(2):131-57.*
4. *Kehlet H. Multimodal approach to control postoperative pathophysiology and rehabilitation. British journal of anaesthesia. 1997 May 1;78(5):606-17.*
5. *Schraag S, Pradelli L, Alsaleh AJ, Bellone M, Ghetti G, Chung TL, Westphal M, Rehberg S. Propofol vs. inhalational agents to maintain general anaesthesia in ambulatory and in-patient surgery: a systematic review and meta-analysis. BMC anesthesiology. 2018 Nov 8;18(1):162.*
6. *Huang Y, Yan T, Lu G, Luo H, Lai Z, Zhang L. Efficacy and safety of remimazolam compared with propofol in hypertensive patients undergoing breast cancer surgery: a single-center, randomized, controlled study. BMC anesthesiology. 2023 Dec 12;23(1):409.*
7. *Ahmed MM, Tian C, Lu J, Lee Y. Total intravenous anesthesia versus inhalation anesthesia on postoperative analgesia and nausea and vomiting after bariatric surgery: a systematic review and meta-analysis. Asian J Anesthesiol. 2021 Dec 1;59(4):135-51.*
8. *Weerink MA, Struys MM, Hannivoort LN, Barends CR, Absalom AR, Colin P. Clinical pharmacokinetics and pharmacodynamics of dexmedetomidine. Clinical pharmacokinetics. 2017 Aug;56(8):893-913.*
9. *Lin TF, Yeh YC, Lin FS, Wang YP, Lin CJ, Sun WZ, Fan SZ. Effect of combining dexmedetomidine and morphine for intravenous patient-controlled analgesia. British journal of anaesthesia. 2009 Jan 1;102(1):117-22.*
10. *Bell RF, Dahl JB, Moore RA, Kalso EA. Perioperative ketamine for acute postoperative pain. Cochrane database of systematic reviews. 2006(1).*
11. *Assouline B, Tramèr MR, Kreienbühl L, Elia N. Benefit and harm of adding ketamine to an opioid in a patient-controlled analgesia device for the control of postoperative pain: systematic review and meta-analyses of randomized controlled trials with trial sequential analyses. Pain. 2016 Dec 1;157(12):2854-64.*
12. *Ali NP, Kanchi M, Singh S, Prasad A, Kanase N. Dexmedetomedine-Ketamine versus Propofol-Ketamine as anaesthetic agents in paediatric cardiac catheterization. Journal of Armed Forces Medical College, Bangladesh. 2014;10(1):19-24.*
13. *Schraag S, Pradelli L, Alsaleh AJ, Bellone M, Ghetti G, Chung TL, Westphal M, Rehberg S. Propofol vs. inhalational agents to maintain general anaesthesia in ambulatory and in-patient surgery: a systematic review and meta-analysis. BMC anesthesiology. 2018 Nov 8;18(1):162.*
14. *Tsaousi GG, Pourzitaki C, Aloisio S, Bilotta F. Dexmedetomidine as a sedative and analgesic adjuvant in spine surgery: a systematic review and meta-analysis of randomized controlled trials. European journal of clinical pharmacology. 2018 Nov;74(11):1377-89.*

15. *Jouguelet-Lacoste J, La Colla L, Schilling D, Chelly JE. The use of intravenous infusion or single dose of low-dose ketamine for postoperative analgesia: a review of the current literature. Pain medicine. 2015 Feb 1;16(2):383-403.*
16. *Kumar V. Comparative study of propofol with ketamine and propofol with butorphanol for total intravenous anaesthesia in short surgical procedures (Doctoral dissertation, Rajiv Gandhi University of Health Sciences (India)).*
17. *How KY, Tan JJ, Roxas MF. ERAS® Society and Asia. InEnhanced Recovery After Surgery: A Complete Guide to Optimizing Outcomes 2020 Mar 31 (pp. 617-622). Cham: Springer International Publishing.*
18. *Oodit R, McQueen K. ERAS for low-and middle-income countries. InEnhanced Recovery After Surgery: A Complete Guide to Optimizing Outcomes 2020 Mar 31 (pp. 623-630). Cham: Springer International Publishing.*
19. *McQueen K, Oodit R, Derbew M, Banguti P, Ljungqvist O. Enhanced recovery after surgery for low-and middle-income countries. World Journal of Surgery. 2018 Apr;42(4):950-2.*
20. *Sarhan MA, Mohammed Alsalom SS, Mahdi Alyami SH, Ali Al Alshahi TM, Alyami MS, Eid Alharbi AN, Sulaiman Murad MH, Mohammed Alshehri SS, Alobaid MM, Ahmed Alnashri AH, Shaar JH. Comparative Effectiveness of Total Intravenous Anesthesia (TIVA) vs. Inhalational Anesthesia. Journal of International Crisis & Risk Communication Research (JICRCR). 2024 Jul 11;7.*
21. *Akine A, Suzuka H, Hayashida Y, Kato Y. Effects of ketamine and propofol on autonomic cardiovascular function in chronically instrumented rats. Autonomic Neuroscience. 2001 Mar 23;87(2-3):201-8.*
22. *Elsherbiny M, Hasanin A, Kasem S, Abouzeid M, Mostafa M, Fouad A, Abdelwahab Y. Comparison of different ratios of propofol-ketamine admixture in rapid-sequence induction of anesthesia for emergency laparotomy: a randomized controlled trial. BMC anesthesiology. 2023 Oct 3;23(1):329.*
23. *Foo TY, Mohd Noor N, Yazid MB, Fauzi MH, Abdull Wahab SF, Ahmad MZ. Ketamine-propofol (Ketofol) for procedural sedation and analgesia in children: a systematic review and meta-analysis. BMC Emergency Medicine. 2020 Oct 8;20(1):81.*
24. *Domene SS, Fulginiti D, Thompson A, Vargas VP, Rodriguez LC, Colón MD, Madera MD, Layton JN, Encarnación MI, Arruarana VS, Cruz CS. Inhalation anesthesia and total intravenous anesthesia (TIVA) regimens in patients with obesity: an updated systematic review and meta-analysis of randomized controlled trials. Journal of anesthesia, analgesia and critical care. 2025 Dec;5(1):1-4.*
25. *Aijima R, Miura D, Takamori A, Kamohara A, Danjo A, Sakaguchi Y, Yamashita Y. Impact of general anesthesia on postoperative complications in orthognathic surgery: a retrospective comparison of total intravenous anesthesia versus volatile anesthesia. Scientific Reports. 2024 Jul 12;14(1):16075.*
26. *Marik PE. Propofol: therapeutic indications and side-effects. Current pharmaceutical design. 2004 Nov 1;10(29):3639-49.*
27. *Reich DL, Silvay G. Ketamine: an update on the first twenty-five years of clinical experience. Canadian Journal of Anaesthesia. 1989 Mar;36(2):186-97.*
28. *Peng K, Liu HY, Wu SR, Liu H, Zhang ZC, Ji FH. Does propofol anesthesia lead to less postoperative pain compared with inhalational anesthesia?: a systematic review and meta-analysis. Anesthesia & Analgesia. 2016 Oct 1;123(4):846-58.*
29. *Sudersan S, Thangavelu R, Segaran S. Intraoperative low-dose ketamine infusion for postoperative pain relief in laparoscopic surgeries–A randomised, double blind controlled clinical trial. Journal of Current Research in Scientific Medicine. 2024 Jan 1;10(1):67-73.*
30. *Wong SS, Choi SW, Lee Y, Irwin MG, Cheung CW. The analgesic effects of intraoperative total intravenous anesthesia (TIVA) with propofol versus sevoflurane after colorectal surgery. Medicine. 2018 Aug 1;97(31):e11615.*
31. *Apfel CC, Korttila K, Abdalla M, Kerger H, Turan A, Vedder I, Zernak C, Danner K, Jokela R, Pocock SJ, Trenkler S. A factorial trial of six interventions for the prevention of postoperative nausea and vomiting. New England journal of medicine. 2004 Jun 10;350(24):2441-51.*
32. *Wang Z, Hu Z, Dai T. The comparison of propofol and midazolam for bronchoscopy: A meta-analysis of randomized controlled studies. Medicine. 2018 Sep 1;97(36):e12229.*
33. *Raeder J, Gupta A, Pedersen FM. Recovery characteristics of sevoflurane-or propofol-based anaesthesia for day-care surgery. Acta anaesthesiologica scandinavica. 1997 Sep;41(8):988-94.*
34. *Ljungqvist O, Scott M, Fearon KC. Enhanced recovery after surgery: a review. JAMA surgery. 2017 Mar 1;152(3):292-8.*