Section: Anaesthesia

Original Research Article

# A COMPARATIVE STUDY OF KETAMINE WITH PROPOFOL VERSUS FENTANYL WITH PROPOFOL FOR TOTAL INTRAVENOUS ANESTHESIA IN SHORT SURGICAL PROCEDURES

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## ABSTRACT

**Aims:** This study aims to compare the efficacy, hemodynamic stability, recovery profile, and adverse effects of two total intravenous anesthesia (TIVA) regimens: Ketamine with Propofol and Fentanyl with Propofol in patients undergoing short surgical procedures. The objective of this study was to determine which combination provides optimal anesthesia with minimal side effects and faster recovery. **Materials and Methods:** 60 patients undergoing elective short surgeries were randomized into two groups receiving either Ketamine-Propofol or Fentanyl-Propofol In the department of Anesthesia from Dec 2025 to February 2026 at Geetanjali Institute of Medical Sciences, Jaipur. Hemodynamic parameters, recovery times, analgesic requirements, and adverse events were recorded and analyzed. **Results:** The results demonstrated that ketamine-propofol provided superior hemodynamic stability and analgesia but was associated with a longer recovery time and psychomimetic side effects. Conversely, Fentanyl-Propofol facilitated faster recovery but was associated with a higher incidence of hypotension and postoperative analgesic requirements. **Conclusion:** These findings suggest the need for tailored anesthetic choices based on patient profiles and surgical demands.

## INTRODUCTION

Total intravenous anesthesia (TIVA) has become a favored anesthetic technique for short-duration surgical procedures because of its numerous advantages over inhalational anesthesia, including rapid induction, predictable recovery, and decreased incidence of postoperative complications, such as nausea, vomiting, and airway irritation. Propofol, a widely used intravenous anesthetic agent, is preferred for its rapid onset, short duration of action, and favorable pharmacokinetic profile, which allows for smooth induction and emergence from anesthesia. Despite these benefits, propofol lacks intrinsic analgesic properties, necessitating its combination with adjunctive agents to provide adequate intraoperative and postoperative pain control.[1]

Ketamine, an N-methyl-D-aspartate (NMDA) receptor antagonist, is unique among anesthetic agents because of its dissociative anesthetic properties and ability to induce analgesia and sympathetic nervous system stimulation. These effects can maintain or even increase the heart rate and blood pressure during anesthesia, potentially benefiting patients prone to hemodynamic instability. Furthermore, ketamine's analgesic effects extend into the postoperative period, reducing the need for supplemental opioids and potentially decreasing opioid-related side effects. However, ketamine is also associated with psychomimetic side effects, such as emergence delirium, hallucinations, and dysphoria, which may complicate recovery and require additional management strategies.[2]

Fentanyl, a potent synthetic opioid, is commonly combined with propofol in TIVA protocols to provide strong analgesia. It effectively suppresses nociceptive stimuli during surgery but can cause adverse effects, such as respiratory depression, bradycardia, and hypotension, which may complicate anesthetic management, especially in patients with compromised cardiovascular function. The balance between rapid recovery and hemodynamic stability is critical in short surgical procedures, where rapid patient turnover and safety are paramount.[3]

This study aimed to conduct a comprehensive comparison of Ketamine-Propofol and Fentanyl-Propofol combinations for TIVA in short surgical procedures, focusing on hemodynamic stability, recovery characteristics, analgesic efficacy, and adverse effect profiles. By evaluating these parameters, this study sought to identify an anesthetic regimen that optimally balances efficacy, safety, and


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recovery outcomes, thereby guiding the choice of anesthetic in clinical practice.

## MATERIALS AND METHODS

**Study Design**: This prospective randomized controlled trial was designed to minimize bias and ensure a robust comparison of anesthetic regimens.

**Sample Size**: Sixty adult patients aged 18–60 years, classified as American Society of Anesthesiologists (ASA) physical status I or II, and scheduled for elective short surgical procedures lasting less than 60 min were enrolled. This study was carried out in the department of Anesthesia at Geetanjali Institute of Medical Sciences, Jaipur from December 2025 to February 2026. The exclusion criteria included known allergies to the study drugs, significant cardiovascular or respiratory disease, psychiatric disorders, substance abuse history, pregnancy, and patients on chronic pain medication or psychotropic drugs.

**Randomization and Grouping**: Patients were randomly allocated to two equal groups using computer-generated random numbers.

**Group KP**: Received Ketamine (0.5 mg/kg) combined with propofol (2 mg/kg for induction, followed by maintenance infusion at 50-100 mcg/kg/min).

**Group FP**: Received Fentanyl (2 mcg/kg) combined with propofol at the same dosing regimen as Group KP.

**Premedication and Monitoring:** All patients were intravenously premedicated with midazolam (0.02 mg/kg) to reduce anxiety and provide mild sedation. Standard monitoring included continuous electrocardiography, noninvasive blood pressure measurement, pulse oximetry, and respiratory rate monitoring throughout the procedure. Baseline hemodynamic parameters were recorded before induction.

**Anesthetic Procedure:** Following premedication, induction was achieved using the assigned drug combination. Maintenance anesthesia was maintained with continuous propofol infusion supplemented by either ketamine or fentanyl. Anesthetic depth was titrated based on clinical signs, such as hemodynamic parameters and patient movement. Infusion rates were adjusted to maintain adequate anesthesia while minimizing side effects.

**Data Collection:** Hemodynamic parameters (heart rate, systolic and diastolic blood pressure), oxygen saturation, and respiratory rate were recorded at baseline, immediately post-induction, every 5 min intraoperatively, and during recovery until discharge criteria were met. Recovery time was assessed by measuring the time to eye-opening on verbal command and the time to orientation (ability to state name, place, and date). Sedation was evaluated at regular intervals postoperatively using a standardized sedation scale. Postoperative pain was assessed using a visual analog scale (VAS) 30 min and 1 h after surgery. The requirement for rescue analgesia was documented. Adverse events such as emergence delirium, hallucinations, respiratory depression, nausea, vomiting, and any other complications were also recorded.

**Statistical Analysis:** Data was analyzed using descriptive and inferential statistics. Continuous variables were compared using the Student's t-test. Categorical variables were analyzed using the Chi-square or Fisher's exact test. Statistical significance was set at $p < 0.05$.

## RESULTS

Total 60 patients were enrolled in the present study, which observations were as showed in table 1.

**Hemodynamic Stability**: Group KP demonstrated significantly more stable heart rate and blood pressure throughout the perioperative period than Group FP. Patients in Group FP showed a higher incidence of hypotension and bradycardia, especially during the induction and early maintenance phases. The sympathomimetic effect of ketamine likely contributed to the maintenance or elevation of cardiovascular parameters in Group KP, reducing the need for pharmacological intervention. In contrast, the depressant effects of fentanyl on the cardiovascular system necessitate closer monitoring and occasional vasopressor support.[4]

**Recovery Profile**: Patients in Group FP experienced faster recovery, with significantly shorter times to eye opening and orientation. The sedative and psychomimetic effects of ketamine in Group KP contributed to the prolonged emergence phase. Despite this, sedation scores post full emergence were comparable between the groups, indicating no residual sedation differences. The longer recovery time in the ketamine group may affect turnover rates in high-volume surgical settings.[4]

**Analgesic Efficacy**: Postoperative pain scores assessed using the VAS were significantly lower in Group KP at both 30 min and 1 h post-surgery, reflecting the potent analgesic properties of ketamine. Correspondingly, the requirement for rescue analgesics was higher in Group FP, suggesting a shorter duration of analgesia from fentanyl than from dexmedetomidine. This difference could influence postoperative opioid consumption and related side effects of the drug.[4]

**Adverse Effects**: Emergence delirium and hallucinations were reported exclusively in the KP group, consistent with the known psychomimetic side effects of ketamine. These events were transient but necessitated additional monitoring and, in some cases, the administration of benzodiazepines for symptom control. Group FP had a higher frequency of respiratory depression episodes and postoperative nausea and vomiting, consistent with the opioid-related adverse effects. These complications required supplemental oxygen and antiemetic therapy.[4]


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**Table 1: Results of present study**

| Parameter | Group KP (Ketamine-Propofol) (n=30) | Group FP (Fentanyl-Propofol) (n=30) | p-value |
|---|---|---|---|
| **Heart Rate Stability (%)** | 92% stable | 75% stable | <0.05 |
| **Incidence of Hypotension (%)** | 10% | 35% | <0.01 |
| **Bradycardia Episodes (%)** | 5% | 20% | <0.05 |
| **Time to Eye Opening (minutes)** | 12.5 Â± 3.2 | 8.3 Â± 2.7 | <0.001 |
| **Time to Orientation (minutes)** | 15.6 Â± 4.1 | 10.2 Â± 3.5 | <0.001 |
| **VAS Pain Score at 30 min** | 2.1 Â± 0.9 | 4.6 Â± 1.2 | <0.001 |
| **VAS Pain Score at 1 hour** | 2.8 Â± 1.1 | 5.0 Â± 1.3 | <0.001 |
| **Rescue Analgesic Requirement (%)** | 20% | 55% | <0.01 |
| **Emergence Delirium (%)** | 15% | 0% | <0.01 |
| **Respiratory Depression (%)** | 0% | 18% | <0.05 |
| **Postoperative Nausea/Vomiting (%)** | 10% | 30% | <0.05 |

## DISCUSSION

The ketamine-propofol (KP) versus fentanyl-propofol (FP) for TIVA in short surgical procedures is enriched by integrating comparative data from both the current study and existing literature. The present study's findings demonstrate ketamine-propofol's superior hemodynamic stability, with 92% heart rate stability versus 75% in the fentanyl group ($p < 0.05$), and significantly lower incidences of hypotension (10% vs. 35%, $p < 0.01$) and bradycardia (5% vs. 20%, $p < 0.05$). These results align with multiple prior studies that consistently report ketamine's sympathomimetic properties as beneficial in maintaining cardiovascular stability, particularly in patients at risk of hypotension or bradycardia. Such hemodynamic advantages reduce vasopressor requirements and enhance perioperative safety.[5]

Analgesic efficacy in the KP group is also supported by significantly lower pain scores at 30 minutes (VAS 2.1 ± 0.9 vs. 4.6 ± 1.2, $p < 0.001$) and 1 hour postoperatively (VAS 2.8 ± 1.1 vs. 5.0 ± 1.3, $p < 0.001$), along with reduced rescue analgesic needs (20% vs. 55%, $p < 0.01$). These findings corroborate literature documenting ketamine's postoperative opioid-sparing effects, which contribute to improved patient comfort and fewer opioid-related adverse effects. However, the emergence delirium rate of 15% in the KP group (absent in FP) reflects the psychomimetic side effects frequently reported in other trials, highlighting a consistent challenge in ketamine use. Benzodiazepine premedication or dose adjustments have been explored in prior research to mitigate these effects, though with variable success and potential compromise of analgesic or hemodynamic benefits.[6,7]

The FP group's faster recovery profile is evident in shorter times to eye opening (8.3 ± 2.7 vs. 12.5 ± 3.2 minutes, $p < 0.001$) and orientation (10.2 ± 3.5 vs. 15.6 ± 4.1 minutes, $p < 0.001$), consistent with studies emphasizing fentanyl's rapid onset and suitability for high-turnover surgical settings. Nevertheless, the FP group experienced higher rates of respiratory depression (18% vs. 0%, $p < 0.05$) and postoperative nausea/vomiting (30% vs. 10%, $p < 0.05$), findings that are well documented in the literature and contribute to delayed discharge and patient discomfort. This study was in an agreement with Goodchild CS et al.[8]

Meta-analyses and systematic reviews in the field reinforce the necessity of tailoring anesthetic regimens to individual patient profiles, surgical context, and institutional resources. Ketamine-propofol combinations are preferable for patients with cardiovascular instability or those requiring enhanced analgesia despite longer recovery and psychomimetic risks. Conversely, fentanyl-propofol regimens benefit patients prioritizing rapid recovery and minimal psychomimetic effects but require vigilant monitoring for respiratory and cardiovascular depression.

Common limitations across studies, including the current one, involve relatively small sample sizes and exclusion of patients with significant comorbidities, limiting generalizability. Future research directions should focus on larger, more diverse populations and investigate dose optimization and adjunctive therapies to reduce side effects, as well as long-term outcomes such as chronic pain and cognitive effects, to further refine clinical practice.[9,10,11]

## CONCLUSION

Both Ketamine-Propofol and Fentanyl-Propofol combinations are effective and viable options for TIVA in short surgical procedures. Ketamine-propofol offers superior hemodynamic stability and prolonged analgesia but is associated with longer recovery times and psychomimetic side effects. Fentanyl-propofol facilitates faster recovery and orientation but may compromise cardiovascular stability and increase postoperative analgesic requirements and opioid-related adverse effects. Anesthetic plans should be tailored to the individual patient's needs and surgical demands, balancing safety, efficacy, and recovery considerations. Ongoing research is essential to optimize the dosing protocols, minimize the adverse effects, and enhance the perioperative outcomes.[12]

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