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Comparative Evaluation of Propofol with Ketamine Versus Propofol with Fentanyl for total Intravenous Anaesthesia in Elective Surgical Procedures: A Prospective Comparative Study

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ABSTRACT

Background: Total intravenous anaesthesia (TIVA) using propofol-based combinations is widely practiced because of its rapid onset, smooth recovery, and improved perioperative stability. Ketamine and fentanyl are commonly used adjuncts with propofol to enhance analgesia and anaesthetic efficacy. This study was designed to compare the efficacy, haemodynamic stability, respiratory effects, and recovery characteristics of propofol with ketamine and propofol with fentanyl combinations in patients undergoing elective surgical procedures.

Materials and Methods: A total of 108 patients belonging to American Society of Anaesthesiologists (ASA) grade I and II were enrolled and randomly divided into two groups of 54 patients each. Group PK received ketamine (0.5 mg/kg) with propofol (3 mg/kg), while Group PF received fentanyl (1 µg/kg) with propofol (3 mg/kg). Heart rate, systolic blood pressure, diastolic blood pressure, respiratory rate, and oxygen saturation were monitored perioperatively.

Results: The onset of induction was significantly faster in Group PK compared to Group PF. Patients of group PK demonstrated better haemodynamic stability with minimal fluctuations in pulse rate and blood pressure. Respiratory rate and oxygen saturation remained within normal physiological limits in both groups. The total requirement of propofol and supplemental drug doses was lower in Group PK. Patient satisfaction was higher in the group PK, whereas transient hypotension and respiratory depression were more common in the fentanyl group.

Conclusion: Both drug combinations provided effective intravenous anaesthesia; however, propofol with ketamine offered superior haemodynamic stability, reduced propofol requirement, preserved respiratory function, and improved patient satisfaction compared to propofol with fentanyl.

Keywords*: Propofol, Ketamine, Fentanyl, Total intravenous anaesthesia, Haemodynamic stability, Oxygen saturation.*

INTRODUCTION

Total intravenous anaesthesia (TIVA) has become an important component of modern anaesthetic practice because of its advantages over conventional inhalational techniques, including rapid induction, smooth recovery, reduced postoperative nausea, and improved haemodynamic control. Propofol-based intravenous anaesthesia is widely preferred due to its rapid onset, short duration of action, and favourable recovery profile. However, propofol alone lacks sufficient analgesic properties and may produce dose-dependent hypotension and respiratory depression, necessitating its combination with adjunctive agents to achieve balanced anaesthesia (1).

Ketamine and fentanyl are among the most commonly used adjuncts combined with propofol during TIVA. Ketamine is a phencyclidine derivative that acts primarily through N-methyl-D-aspartate (NMDA) receptor antagonism. It provides profound analgesia, sedation, and amnesia while preserving airway reflexes and spontaneous respiration (2). In addition,

ketamine stimulates the sympathetic nervous system, thereby maintaining cardiovascular stability during anaesthesia (2,3). Fentanyl, a potent synthetic opioid analgesic, is frequently used in anaesthetic practice because of its rapid onset and effective analgesic action. Nevertheless, fentanyl may be associated with respiratory depression, bradycardia, and hypotension, especially when combined with higher doses of propofol (1,4).

Previous studies have demonstrated that combining propofol with ketamine may reduce the haemodynamic instability commonly associated with propofol administration. Smischney et al. reported that ketofol significantly improved haemodynamic stability during induction compared with propofol alone (5). Similarly, Bajwa et al. observed that the propofol with ketamine combination provided superior cardiovascular stability and effective analgesia compared with propofol with fentanyl during total intravenous anaesthesia (6). Hernández et al. also reported that ketamine with propofol was comparable to the conventional propofol with fentanyl regimen with respect to anaesthetic efficacy and recovery characteristics (7).

Several investigators have further emphasized the role of ketofol in reducing perioperative adverse effects while maintaining adequate sedation and analgesia (8,9). Studies conducted in both adult and paediatric populations have shown that ketamine-containing combinations preserve respiratory function more effectively than opioid-based regimens (10). The complementary pharmacological actions of ketamine and propofol help counterbalance the adverse haemodynamic effects of each individual drug, thereby producing stable intraoperative conditions. (5,8)

Despite the widespread use of these drug combinations, comparative data regarding their perioperative efficacy, haemodynamic effects, respiratory safety, and patient satisfaction remain limited in the Indian population. Therefore, the present study was undertaken to compare the efficacy of propofol with ketamine versus propofol with fentanyl combinations in patients undergoing elective surgical procedures at a tertiary care teaching hospital.

MATERIALS AND METHODS

This prospective comparative observational study was conducted in the Department of Anaesthesiology at Prathima Relief Institute of Medical Sciences, Hanamkonda, Telangana, from May 2024 to June 2025. A total of 108 patients scheduled for elective surgical procedures were enrolled in the study after obtaining written informed consent. Patients were randomly allocated into two equal groups consisting of 54 patients each. Group PK (n=54) patients received propofol in combination with ketamine and group PF (n=54) patients received propofol in combination with fentanyl.

Inclusion Criteria: Patients aged between 20-60 years; both genders, ASA physical status grade I and II, undergoing elective surgical procedures under intravenous anaesthesia and willing to provide informed written consent

Exclusion Criteria: Patients with known hypersensitivity to propofol, ketamine, fentanyl, severe cardiovascular disease, respiratory disorders including chronic obstructive pulmonary disease and bronchial asthma, uncontrolled hypertension, psychiatric illness, hepatic or renal dysfunction, pregnant and lactating women, with anticipated difficult airway and unwilling to participate in the study.

All patients underwent detailed pre-anaesthetic assessment one day prior to surgery. A comprehensive clinical history was obtained, followed by general physical examination and systemic examination. Baseline investigations including CBC, urine routine examination, blood sugar estimation, renal function tests, ECG and chest X-ray were performed.

Patients were advised overnight fasting for at least 6 hours before surgery. On arrival to the operation theatre, intravenous access was secured using an 18G intravenous cannula. Baseline parameters including heart rate, systolic blood pressure (SBP), diastolic blood pressure (DBP), respiratory rate, and peripheral oxygen saturation (SpO_2) were recorded before induction. No sedative premedication was administered before surgery.

Patients in Group PK received Ketamine at a dose of 0.5 mg/kg body weight intravenously over 15 seconds, followed by propofol at a dose of 3mg/kg body weight intravenously. Patients in Group PF received Fentanyl at a dose of 1µg/kg body weight intravenously over 15 seconds, followed by propofol at a dose of 3mg/kg body weight intravenously Supplemental oxygen was administered throughout the procedure using face mask oxygenation. Additional doses of ketamine or fentanyl were administered whenever clinically required to maintain adequate anaesthetic depth and patient comfort during surgery.

All parameters were recorded at the following intervals baseline, 1 min after induction, 5 min, 10 min, 20 min and immediate postoperative period in both study groups such as heart rate, systolic blood pressure (SBP), diastolic blood pressure (DBP), respiratory rate, oxygen saturation (SpO_2), onset time of induction, total dose of propofol used, number of supplemental doses administered, recovery time. Patients were monitored for perioperative complications including pain during injection, nausea and vomiting, apnoea, oxygen desaturation, excessive sedation and emergence reactions

Postoperative patient satisfaction was evaluated using a structured feedback questionnaire and categorized as good, satisfactory, not satisfied and no comments

Statistical Analysis

The collected data was extracted into Microsoft Excel sheet and analysed using SPSS v. 25.0. Continuous variables were expressed as mean±standard deviation (SD), while categorical variables were presented as frequencies and percentages. Comparisons between the two groups were performed using Student's independent t-test for continuous variables and Chi-square test for categorical variables. A p-value of less than 0.05 was considered statistically significant.

RESULTS

Table 1: Age and gender wise distribution of study participants.

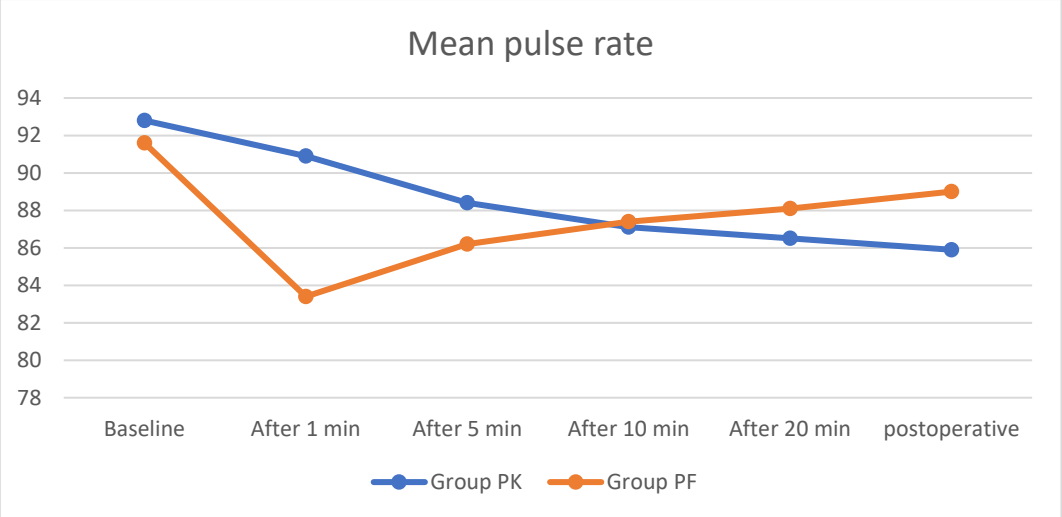
Age (In years)	Group PK (n=54)		Group PF (n=54)	
	Male	Female	Male	Female
21-30	24 (44.4%)	10 (18.5%)	7 (12.9%)	9 (16.7%)
31-40	6 (11.1%)	2 (3.7%)	20 (37%)	10 (18.5%)
41-50	2 (3.7%)	1 (1.8%)	4 (7.4%)	2 (3.7%)
51-60	5 (9.25%)	4 (7.4%)	1 (1.8%)	1 (1.8%)

Table 2: Distribution of cases according to type of surgery.

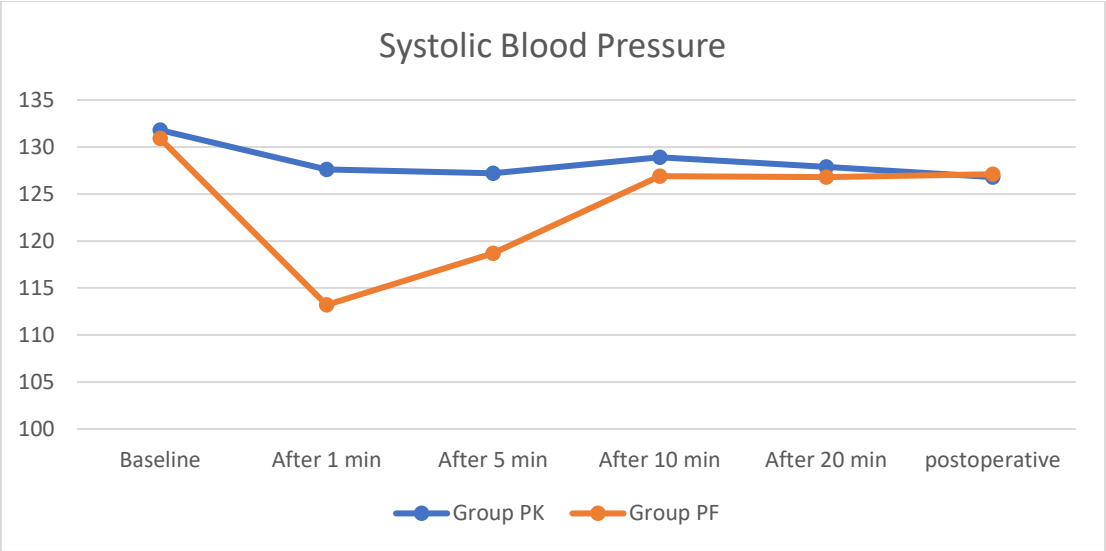
Type of Surgery	Group PK (n=54)	Group PF (n=54)
Open reduction & internal fixation	9 (16.7%)	8 (14.8%)
K-nail removal	3 (5.5%)	3 (5.5%)
Curettage	7 (12.9%)	7 (12.9%)
Sequestrectomy	7 (12.9%)	6 (11.1%)
Amputation	2 (3.7%)	3 (5.5%)
Skin grafting	10 (18.5%)	9 (16.7%)
MTP and tubal ligation	16 (29.6%)	18 (33.3%)

Table 3: Mean values of propofol requirement and supplemental doses.

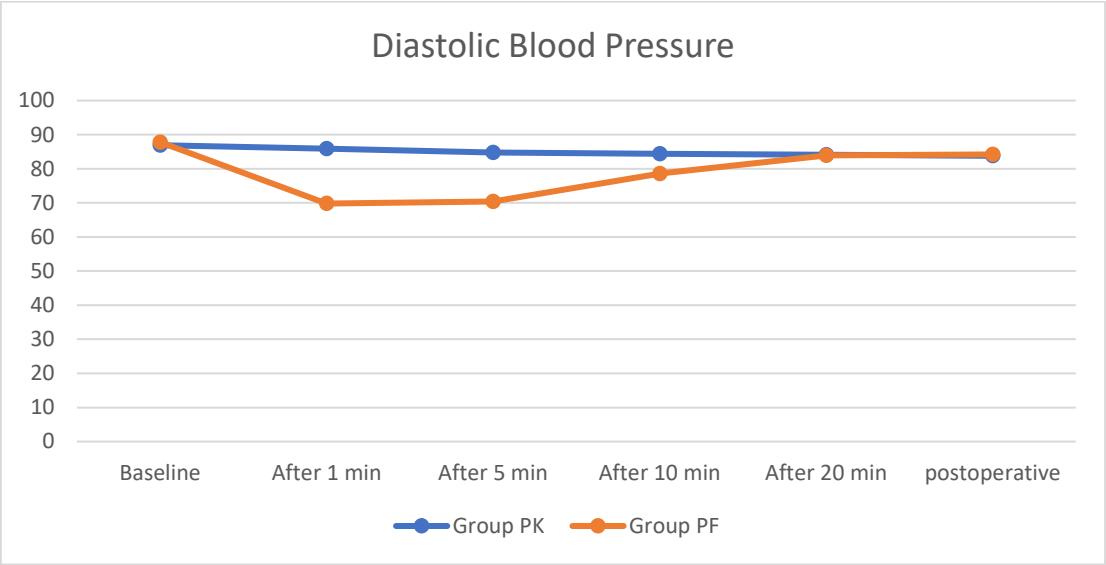
Parameter	Group PK (Mean ± SD)	Group PF (Mean ± SD)	p-value
Onset time of induction	42.1±4.72	48.6±5.18	0.001
Induction dose of propofol (mg)	138.4 ± 10.92	156.7 ± 18.64	
Total dose of propofol (mg)	214.8 ± 11.86	235.9 ± 13.78	0.05
Number of supplemental doses	1.9 ± 1.8	3.1 ± 1.9	



Graph 1: Mean pulse rate.



Graph 2: Systolic blood pressure.



Graph 3: Diastolic blood pressure.

Table 4: Mean respiratory rate and oxygen saturation.

Time Interval	Respiratory Rate Group PK	Respiratory Rate Group PF	SpO_2 (%) Group PK	SpO_2 (%) Group PF
Baseline	14.8 ± 2.3	14.7 ± 1.9	97.8 ± 1.0	96.8 ± 1.1
After 1 min	15.1 ± 2.6	13.1 ± 1.5	98.1 ± 1.1	97.1 ± 1.2
After 5 min	15.3 ± 2.4	13.4 ± 1.4	98.3 ± 0.8	97.4 ± 1.3
After 10 min	14.8 ± 2.0	14.2 ± 2.0	98.4 ± 0.9	97.5 ± 1.5
After 20 min	14.6 ± 1.9	14.5 ± 3.1	98.5 ± 0.9	98.4 ± 1.0
Postoperative	14.3 ± 2.0	14.7 ± 1.7	98.7 ± 0.9	98.6 ± 1.1

Table 5: Patient feedback regarding anaesthetic procedure.

Feedback	Group PK	Group PF
Good	39 (72.2%)	34 (63%)
Satisfactory	8 (14.8%)	13 (24.1%)
Not satisfied	3 (5.5%)	3 (5.5%)
No comments	4 (7.4%)	4 (7.4%)

DISCUSSION

Total intravenous anaesthesia (TIVA) using propofol-based combinations has become increasingly popular because of its rapid induction, smooth recovery profile, reduced postoperative complications, and improved patient comfort (3). The present study compared the efficacy and perioperative effects of propofol with ketamine and propofol with fentanyl combinations in patients undergoing elective surgical procedures. In the present study, the onset of induction was significantly faster in the group PK compared to the group PF. This observation is consistent with the study conducted by Bajwa et al., who reported rapid induction and satisfactory sedation with ketamine with propofol combinations during TIVA (6). Propofol is a highly lipophilic hypnotic agent that rapidly crosses the blood brain barrier, resulting in quick onset of anaesthesia (1). Ketamine further enhances induction quality because of its dissociative anaesthetic and analgesic properties. In contrast, fentanyl primarily provides analgesia and may not contribute substantially to the speed of induction (11).

The total dose of propofol required during surgery was lower in the ketamine group compared to the fentanyl group. Similar findings were reported by Smischney et al., who demonstrated that ketamine supplementation reduced propofol requirements while maintaining adequate anaesthetic depth (5). The synergistic interaction between ketamine and propofol allows lower doses of each drug to be administered, thereby minimizing dose-dependent adverse effects (12).

Haemodynamic stability was notably better in the propofol with ketamine group. In the present study, systolic and diastolic blood pressures remained comparatively stable throughout the perioperative period in group PK, whereas group PF demonstrated significant reductions in blood pressure immediately after induction. Propofol is known to cause vasodilatation and myocardial depression, leading to hypotension (4). Ketamine, due to its sympathomimetic action, counteracts these cardiovascular depressant effects by increasing catecholamine release and maintaining systemic vascular resistance (9). Similar results were observed by Nazemroaya et al., who reported improved cardiovascular stability with ketofol compared to fentanyl-containing regimens (9).

The pulse rate in the present study showed fewer fluctuations in the ketamine group, whereas the fentanyl group demonstrated an initial decrease followed by variable changes during surgery. These findings correlate with those reported by Hernández et al., who found more stable haemodynamic parameters with propofol and ketamine combinations compared with propofol and fentanyl anaesthesia (7).

Respiratory parameters including respiratory rate and oxygen saturation remained within normal limits in both groups throughout the study period. However, transient respiratory depression and episodes of oxygen desaturation were more frequently observed in the fentanyl group. Fentanyl, being a potent opioid, is associated with dose-dependent respiratory depression due to suppression of the respiratory centre (13). In contrast, ketamine preserves airway reflexes and spontaneous respiration, thereby reducing the incidence of perioperative respiratory complications (14). Previous studies have similarly highlighted the respiratory safety profile of ketamine containing combinations during procedural sedation and anaesthesia (5,14)

Patient satisfaction was higher in the group PK in the present study. Better analgesia, haemodynamic stability, and reduced perioperative discomfort may have contributed to improved patient acceptance. Although recovery time was marginally longer in the ketamine group, recovery quality remained satisfactory and clinically acceptable. Similar observations were made by Erden et al., who reported favourable recovery characteristics and better perioperative comfort with ketamine with propofol combinations (10). Pain during propofol injection was the most common adverse effect observed in both groups, although its incidence was relatively lower in patients receiving ketamine. Koo et al. demonstrated that low-dose ketamine effectively reduces propofol injection pain because of its analgesic action (2). Other postoperative complications such as nausea, vomiting, and transient apnoea were mild and self-limiting.

CONCLUSION

The present study demonstrated that both propofol with ketamine and propofol with fentanyl combinations provided effective total intravenous anaesthesia with satisfactory operative conditions and adequate respiratory stability. However, the propofol with ketamine combination showed superior haemodynamic stability, faster induction, reduced propofol requirement, and better preservation of cardiovascular parameters during the perioperative period. Patients receiving ketamine also reported higher satisfaction with fewer respiratory complications and improved overall recovery characteristics. Based on these findings, the propofol with ketamine combination may be considered a safer and more effective alternative to propofol with fentanyl for elective surgical procedures requiring balanced intravenous anaesthesia.

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