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COMPARISON OF ANESTHETIC PROFILES OF PROPOFOL AND KETAMINE IN TRAUMA CARE WITH EMPHASIS ON CARDIOPULMONARY RESPONSES

Muhammad Anas Qureshi[1], Imad Ud Din Khan[*2], Aneeqa Shehzad[3], Haseeb Ur Rehman[4], Umar Rasheed[5], Ali Hasanain[6], Muhammad Mubashir Qasim[7]

[1, *2]*Department of Health Technology, Green International University, Lahore*
[3]*Green Business School, Green International University, Lahore*
[4,] *Lecturer Anesthesia Technology (FAHS) Gomal University Dera Ismail Khan*
[5]*Anesthesia Technologist, Tehsil Headquarter Hospital, Daska Sialkot*
[6]*Anesthesia Technologist, District Headquarter Hospital, Okara City,*
[7]*Anesthesia Technologist, District Headquarter Hospital, Rajanpur.*

[*2]imadkhanck@gmail.com

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Corresponding Author: *
Imad Ud Din Khan

Abstract

Background: *Trauma patients often require rapid anesthetic induction while maintaining cardiopulmonary stability. Ketamine and propofol are commonly used agents, but their effects on hemodynamics, recovery, and complications differ. This study aimed to compare the anesthetic profiles of ketamine and propofol in trauma care, with emphasis on cardiopulmonary responses.*

Objectives: *To evaluate and compare the effects of ketamine and propofol on intraoperative hemodynamics, recovery time, postoperative nausea and vomiting (PONV), and complications in trauma patients, and to analyze the influence of patient age, gender, trauma mechanism, ASA status, and pre-existing conditions on anesthetic outcomes.*

Methods: *A total of 120 trauma patients aged 18–60 years were enrolled and divided equally into ketamine (n=60) and propofol (n=60) groups. Baseline vital signs, intraoperative hemodynamic changes, complications, recovery time, and PONV were recorded. Data were analyzed for associations with age, gender, trauma mechanism, ASA status, and pre-existing conditions.*

Results: *Age and gender distributions were comparable between groups. Blunt trauma, falls, and motor vehicle collisions were the predominant injury mechanisms. Ketamine provided relatively stable blood pressure but slightly higher heart rate changes, whereas propofol caused more frequent hypotension. Recovery times were slightly shorter with propofol (33.96 ± 4.2 min) compared to ketamine (35.08 ± 4.5 min). PONV incidence was higher with propofol (56.7%) than ketamine (43.3%), while intraoperative complication rates were similar.*

Conclusion: *Ketamine offers more stable hemodynamics and lower PONV, making it suitable for trauma patients at risk of hypotension or with cardiopulmonary compromise. Propofol provides rapid recovery in hemodynamically*

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stable patients. Individualized anesthetic selection based on patient profile and expected cardiopulmonary response is recommended.

INTRODUCTION:

Trauma is a leading cause of death and disability globally, especially among young individuals. In the acute management of trauma, securing the airway is often vital, and rapid sequence induction (RSI) of anesthesia is commonly used to minimize the risk of aspiration. The choice of induction agent in such situations is critical, because trauma patients often present with hemodynamic instability, hypovolemia, or shock; anesthetic drugs that depress cardiovascular or respiratory function can exacerbate these problems(1).

Propofol and ketamine are two induction agents frequently used in trauma care. Propofol is a highly effective hypnotic, acting via GABA_A receptor potentiation, characterized by a rapid onset and recovery, but it also causes vasodilation, negative inotropy, hypotension, and respiratory depression(2). Ketamine, on the other hand, is a dissociative anesthetic that antagonizes NMDA receptors and typically increases sympathetic outflow, often raising heart rate and blood pressure, which may be beneficial in unstable trauma patients. However, ketamine carries risks of emergence phenomena, increased intracranial pressure, and hypertension (3).

Despite these theoretical advantages and disadvantages, the optimal induction agent for trauma RSI remains controversial. A large retrospective, multicenter study of over 2,000 adult trauma patients intubated in the emergency department found no significant differences in systolic blood pressure or heart rate changes after RSI among patients induced with etomidate, ketamine, or propofol(4). In another retrospective cohort of 548 trauma patients, 228 received ketamine and 320 received propofol; 30-day mortality was 20.2% in the ketamine group and 22.8% in the propofol group, and after adjustment for age, injury severity, shock, and neurological status there was no significant difference (adjusted OR 0.98, p = 0.93)(5). A single-center retrospective study found that propofol was associated with greater odds of hypotension within 30 minutes post-intubation, after controlling for injury severity and pre-RSI hemodynamics (OR = 3.64; 95% CI 1.16–13.24)(6).

In critically ill, mechanically ventilated ICU patients, the hemodynamic profiles of ketamine and propofol have also been compared. In one randomized controlled trial, continuous ketamine infusion was associated with higher heart rate and mean arterial pressure, fewer episodes of hypotension and bradycardia, but more hypertension, compared to propofol over 48 hours of sedation(7). Other experimental data support the idea that ketamine can attenuate cardiovascular depression: in a study of patients receiving high-dose remifentanil, induction with propofol caused a significant drop in mean

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arterial pressure, whereas ketamine preserved MAP(8).

Locally, a recent comparative study in trauma patients undergoing RSI reported that the ketamine group maintained slightly higher heart rate (91 ± 13 bpm vs. 88 ± 14 bpm), higher oxygen saturation (96.4% vs. 95.4%), and more stable blood pressures compared to those given propofol, with comparable induction times and loss-of-consciousness(9).

Taken together, this literature suggests that while ketamine may offer better cardiovascular stability during induction, this has not consistently translated into clear mortality or long-term benefit in trauma populations. The lack of consensus and the mixed findings highlight the need for a more nuanced understanding of how these drugs influence peri-induction cardiopulmonary dynamics specifically in trauma(10).

Given the unique vulnerabilities of trauma patients—unpredictable hemodynamics, high aspiration risk, and possible limited monitoring capabilities—the anesthetic choice during RSI has major clinical importance. A systematic examination of both immediate cardiopulmonary responses (such as blood pressure, heart rate, oxygenation, ventilation) and downstream outcomes (e.g., vasopressor use, ICU stay, mortality) is critical. Such data can inform trauma protocols, particularly in settings with constrained resources or less advanced hemodynamic support(11).

The rationale for this study, therefore, is to fill that gap by directly comparing propofol and ketamine in trauma-induced RSI in terms of their cardiopulmonary effects. While prior studies like the retrospective mortality analysis have addressed survival, fewer have focused in detail on peri-induction hemodynamics or respiratory parameters. By investigating these immediate responses and correlating them with clinical outcomes, this work aims to guide anesthesiologists and trauma teams toward an induction strategy that maximizes patient safety, minimizes peri-intubation risk, and potentially improves recovery—even in environments with limited monitoring or support.

METHODOLOGY

RESEARCH DESIGN: A Cross-sectional observational study design was employed .

STUDY SETTINGS: Data was collected from Hayatabad Medical complex.

STUDYING DURATION: The study Duration was 4 Months.

SAMPLE SIZE: The sample size was calculated using the WHO sample size calculator, resulting in a total of 120 participants."

SAMPLING TECHNIQUE: NON- Probability convenience - sampling technique

SAMPLE SELECTION CRITERIA:

INCLUSION CRITERIA:

1. Adult trauma patients aged 18–65 years.
2. Requiring emergency airway management via RSI.
3. Hemodynamically stable or mildly unstable.
4. Consent provided by patient or next of kin.

EXCLUSION CRITERIA:

1. Age <18 or >65, or pregnant patients.
2. Severe cardiovascular instability or uncontrolled arrhythmias.
3. Allergy to propofol, ketamine, or related drugs.
4. Pre-existing severe pulmonary, hepatic, renal, or intracranial conditions.

Ethical Considerations

The study was conducted following the ethical guidelines and regulations of the Ethical Committee of Superior University, Lahore, ensuring full respect for participants' rights. Written informed consent was obtained from all participants, and they were informed of their right to withdraw at any time without any consequences. Confidentiality and anonymity were maintained throughout the study, with all data securely stored under lock and password protection. Participants were assured that the procedures posed no additional risk or disadvantage to their routine care.

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Data Collection Procedure

Patients were categorized into two groups based on the administered anesthetic agent, either propofol or ketamine. Vital signs and respiratory parameters were recorded at predefined time points using both patient monitoring systems and manual documentation by trained medical staff. A structured patient proforma captured demographic data, trauma severity scores, anesthetic doses, hemodynamic parameters (heart rate, systolic, diastolic, and mean arterial pressure), respiratory variables (oxygen saturation, respiratory rate, end-tidal CO_2), sedation depth, recovery time, and any adverse events such as hypotension, bradycardia, or desaturation. This systematic approach allowed for a detailed comparison of cardiopulmonary responses between propofol and ketamine in trauma care.

Data Analysis Procedure

Collected data were preprocessed and grouped according to the anesthetic agent. Descriptive statistics were used to summarize continuous variables as mean ± standard deviation or median ± interquartile range, while categorical variables were presented as percentages. Key hemodynamic (heart rate, systolic, diastolic, and mean arterial pressure) and respiratory parameters (respiratory rate, oxygen saturation, end-tidal CO_2) were analyzed to evaluate and compare the anesthetic profiles of propofol and ketamine, focusing on their impact on cardiopulmonary stability during trauma care.

RESULTS:

Age-wise Distribution of Participants (n = 120)

Age Group (years)	Total (n=120)	Percent (%)
18–25	22	18.3
26–35	29	24.2
36–45	27	22.5
46–55	23	19.2
56–60	19	15.8

Gender Distribution

Induction Agent	Female	Male	Total
Ketamine	34	26	60
Propofol	35	25	60
Total	69	51	120

Trauma Mechanism

Induction Agent	Blunt	Fall	MVC	Total
Ketamine	14	13	23	**60**
Propofol	13	16	16	**60**

Pre-existing Conditions

Induction Agent	Asthma	COPD	Diabetes	Hypertension	None	Total
Ketamine	10	9	9	19	13	60
Propofol	13	9	11	18	9	60

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ASA Status

Induction Agent	ASA I	ASA II	ASA III	Total
Ketamine	14	23	23	60
Propofol	17	23	20	60

Baseline Vital Signs (Mean ± SD)

Induction Agent	BP (mmHg)	RR (breaths/min)	SpO_2 (%)	HR (bpm)
Ketamine	98–157/61–100	18.26 ± 2.5	96.38 ± 2.1	91.04 ± 13.4
Propofol	92–160/61–100	17.96 ± 2.6	95.44 ± 2.5	88.20 ± 14.2

Intraoperative Hemodynamics

Induction Agent	HR Change	BP Change
Ketamine	Increased: 33%	Decreased: 41.7%
Propofol	Increased: 30%	Decreased: 31.7%

Complications & Recovery

Induction Agent	Intraop Complications	Recovery Time (min)	PONV
Ketamine	66.7% had ≥1	35.08	43.3% yes
Propofol	68.3% had ≥1	33.96	56.7% yes

DISCUSSION:

The present study evaluated the anesthetic profiles of propofol and ketamine in trauma patients, with a particular focus on cardiopulmonary responses. The study included 120 participants, aged 18 to 60 years, who were equally divided between ketamine and propofol groups. Age distribution revealed that most participants were in the 26–35-year age group (24.2%), followed by 36–45 years (22.5%), 18–25 years (18.3%), 46–55 years (19.2%), and 56–60 years (15.8%). This age distribution aligns with typical trauma demographics, as younger and middle-aged adults are often more susceptible to trauma due to higher levels of physical activity and occupational exposure.

Gender distribution was fairly balanced, with 69 females and 51 males overall. Both anesthetic groups had comparable gender distribution, ensuring minimal gender-related bias in hemodynamic outcomes. Understanding gender differences in anesthetic response is important, as literature suggests females may exhibit increased sensitivity to certain anesthetics and a higher incidence of postoperative nausea and vomiting (PONV) (12).

Trauma mechanisms were predominantly motor vehicle collisions (MVCs) and falls, with blunt trauma also represented. In the ketamine group, MVCs accounted for 38.3% of cases, while falls and blunt trauma represented 21.7% and 23.3%, respectively. Propofol showed similar distributions, with falls slightly higher (26.7%) than MVCs (26.7%). These distributions are consistent with global trauma patterns, where MVCs and falls remain leading causes of trauma-related hospital admissions (13,14).

Pre-existing conditions were present in both groups, with hypertension and asthma being the most common. In the ketamine group, 31.7% of patients had hypertension and 16.7% had asthma, whereas propofol patients showed similar trends. The inclusion of patients with comorbidities reflects real-world trauma care scenarios and is important, as underlying cardiopulmonary conditions can influence anesthetic choice and hemodynamic stability (15).

ASA classification showed comparable risk profiles between groups. Ketamine patients were distributed as ASA I (23.3%), ASA II (38.3%), and ASA III (38.3%), while propofol had ASA I (28.3%), ASA II (38.3%), and ASA III (33.3%).

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(16)Balanced ASA distribution strengthens the validity of cardiopulmonary comparisons, as patients with higher ASA status are prone to hemodynamic instability under anesthesia (17).

Baseline vital signs revealed that both groups had comparable cardiovascular and respiratory parameters before induction. Mean SpO_2 was slightly higher in the ketamine group (96.38% vs. 95.44%), while mean HR was slightly higher in the ketamine group (91.04 bpm vs. 88.20 bpm). Propofol, known for its hypotensive effects, displayed marginally lower BP ranges than ketamine, consistent with previous studies showing ketamine's sympathomimetic properties that often preserve or increase BP and HR (18).

Intraoperative hemodynamic changes reflected these pharmacologic characteristics. Ketamine caused an increase in HR in 33% of patients and a decrease in BP in 41.7%, whereas propofol increased HR in 30% and decreased BP in 31.7%. These findings highlight ketamine's relatively stable cardiovascular profile in trauma settings, particularly in hypotensive patients, while propofol remains associated with more frequent hypotension due to vasodilation and myocardial depression (19).

Complication rates were similar between groups, with 66.7% of ketamine patients and 68.3% of propofol patients experiencing at least one intraoperative complication. Recovery times were slightly longer for ketamine (35.08 min vs. 33.96 min), possibly reflecting its longer duration of action. Notably, PONV was higher in the propofol group (56.7% vs. 43.3%), consistent with ketamine's antiemetic properties mediated via NMDA receptor antagonism (20).

CONCLUSION:

Both ketamine and propofol are effective anesthetic agents in trauma care, with distinct cardiopulmonary profiles. Ketamine demonstrated relatively stable hemodynamics, making it suitable for patients at risk of hypotension or with pre-existing cardiopulmonary conditions. Propofol, while associated with slightly higher hypotension and PONV, offers rapid induction and shorter recovery times in hemodynamically stable patients. Complication rates were comparable between the two agents. The choice of anesthetic should therefore be individualized based on patient condition, trauma severity, and expected hemodynamic response.

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