

The Role of Ketamine in Sedating Hemodynamically Unstable ICU Patients

Amit Kumar¹, Jag Mohan Kumar², Kunal Raj³, Lal Chand Tudu⁴, Pradip Kumar Bhattacharya⁵

¹Senior Resident, Department of Critical care of Medicine, Rajendra Institute of Medical Sciences, Ranchi, Jharkhand, India

²Senior Resident, Department of Critical Care Medicine, Rajendra Institute of Medical Sciences, Ranchi, Jharkhand, India

³Senior Resident, Department of Critical Care Medicine, Rajendra Institute of Medical Sciences, Ranchi, Jharkhand, India

⁴Assistant Professor, Department of Critical Care, Rajendra Institute of Medical Sciences, Ranchi, Jharkhand, India

⁵HOD, Department of Critical Care Medicine, Rajendra Institute of Medical Sciences, Ranchi, Jharkhand, India

Received: 11-07-2025 / Revised: 10-08-2025 / Accepted: 11-09-2025

Corresponding Author: Kunal Raj

Conflict of interest: Nil

Abstract:

Background: Sedation in critically ill patients is essential for optimizing comfort and facilitating mechanical ventilation. However, the choice of sedative agent in hemodynamically unstable patients remains challenging, as most conventional sedatives can exacerbate hypotension. Ketamine, with its sympathomimetic and cardiovascular supportive effects, may offer an advantage in this subgroup.

Aim: To evaluate the efficacy and safety of ketamine for sedation in hemodynamically unstable intensive care unit (ICU) patients.

Methods: A retrospective observational study was conducted over 12 months at the Department of Critical Care Medicine (CCM) of Rajendra Institute of Medical Sciences (RIMS), Ranchi. Records of 55 adult patients who required sedation while being hemodynamically unstable and received ketamine were analyzed. Data on demographics, clinical diagnosis, hemodynamic parameters, sedation adequacy, vasopressor requirement, and outcomes were collected. Statistical analysis was performed using SPSS version 23.0, with $p < 0.05$ considered significant.

Results: The mean age of patients was 52.7 ± 13.4 years, with 58.2% males. Septic shock was the most common indication for ICU admission (36.4%). Following ketamine administration, systolic blood pressure and mean arterial pressure improved significantly ($p < 0.001$), while heart rate remained stable. Adequate sedation was achieved in 87.3% of patients with ketamine alone, and vasopressor requirement decreased in 54.5% of cases. Overall ICU survival was 69.1%, with significantly better outcomes in patients whose vasopressor needs decreased ($p = 0.012$).

Conclusion: Ketamine was effective in providing adequate sedation and improving hemodynamic stability in critically ill, unstable patients. It also reduced vasopressor requirements and was associated with improved survival outcomes, making it a valuable sedative choice in this high-risk population.

Recommendations: Ketamine may be considered as a first-line sedative in hemodynamically unstable ICU patients where conventional sedatives may worsen hypotension. Further large-scale prospective trials are recommended to validate these findings and establish standardized dosing guidelines.

Keywords: Ketamine, ICU sedation, Hemodynamic instability, Vasopressors, Critical care.

This is an Open Access article that uses a funding model which does not charge readers or their institutions for access and distributed under the terms of the Creative Commons Attribution License (<http://creativecommons.org/licenses/by/4.0>) and the Budapest Open Access Initiative (<http://www.budapestopenaccessinitiative.org/read>), which permit unrestricted use, distribution, and reproduction in any medium, provided original work is properly credited.

Introduction

Sedation in critically ill patients is a cornerstone of intensive care management, aimed at reducing anxiety, facilitating mechanical ventilation, and optimizing patient comfort. However, the choice of sedative agent becomes challenging in

hemodynamically unstable patients, as many commonly used drugs such as propofol, midazolam, and dexmedetomidine are associated with hypotension and cardiovascular depression [1,2]. This adverse effect is particularly detrimental in

patients already requiring vasopressor support, where further reductions in blood pressure may compromise tissue perfusion and worsen outcomes [3]. Hence, the selection of an appropriate sedative agent with minimal hemodynamic compromise is of paramount clinical importance.

Ketamine, a phencyclidine derivative, has emerged as a promising alternative sedative in the (ICU). Its unique pharmacological profile includes N-methyl-D-aspartate (NMDA) receptor antagonism, preservation of airway reflexes, and sympathomimetic properties, which may result in cardiovascular stimulation rather than depression [4]. Unlike other sedatives, ketamine has been shown to maintain or even increase blood pressure and heart rate by enhancing endogenous catecholamine release [5]. These properties make ketamine particularly suitable for patients in septic shock or those with unstable hemodynamics.

Recent studies have highlighted the expanding role of ketamine in critical care. It has been used not only for sedation but also for analgesia and as an adjunct to reduce opioid consumption, thus minimizing opioid-related complications [6]. In hemodynamically unstable patients, ketamine may help reduce the requirement for vasopressors while providing adequate sedation and analgesia [7]. Moreover, ketamine's neuroprotective effects and potential benefits in refractory status asthmaticus and status epilepticus further extend its utility in ICU practice [8].

Despite these advantages, concerns regarding ketamine include the risk of psychomimetic effects, excessive salivation, and potential for increased intracranial pressure, though recent evidence has challenged some of these concerns [9]. In the last few years, several retrospective and prospective studies have suggested that ketamine is safe and effective in ICU patients, including those with cardiovascular instability [10,11]. Nevertheless, evidence remains limited, and large-scale clinical trials are required to establish its role as a first-line sedative in this subgroup. Given the limited literature in the Indian context and the ongoing need for evidence-based sedative strategies in unstable ICU patients, this study aims to evaluate the use of ketamine for sedation in hemodynamically unstable patients admitted to the ICU at a tertiary care center.

Methodology

Study Design: This study was designed as a retrospective observational study.

Study Setting: The study was conducted in the Department of Critical Care Medicine at Rajendra Institute of Medical Sciences (RIMS), Ranchi, which is a tertiary care referral center. The ICU of RIMS, Ranchi caters to critically ill patients from

diverse clinical backgrounds, making it an appropriate setting for the present study.

Study Duration: The data were collected retrospectively over a 12-month period, covering all eligible ICU admissions during this timeframe.

Participants: A total of 55 patients who fulfilled the inclusion criteria were enrolled in this study. All participants were adults admitted to the ICU during the study period who required sedation and were hemodynamically unstable.

Inclusion Criteria

- Adult patients (age ≥ 18 years) admitted to the ICU.
- Patients requiring sedation while being hemodynamically unstable (defined as systolic blood pressure < 90 mmHg or requiring vasopressor support).
- Patients who received ketamine as the primary sedative agent.

Exclusion Criteria

- Patients below 18 years of age.
- Patients with known hypersensitivity to ketamine.
- Patients with psychiatric disorders or a history of substance abuse.
- Patients with incomplete medical records or missing data relevant to the study.

Bias: To minimize bias, all available patient records during the study period that met the eligibility criteria were included. Selection bias was reduced by using consecutive sampling. Information bias was minimized by cross-checking patient files, ICU charts, and electronic records for consistency.

Data Collection: Data were collected retrospectively from ICU records, case files, and electronic hospital databases. Relevant parameters such as demographic details, clinical diagnosis, hemodynamic parameters, dose and duration of ketamine used, concomitant medications, need for vasopressors, and patient outcomes were recorded in a structured data collection sheet.

Procedure: The retrospective analysis involved reviewing the sedation practices in hemodynamically unstable ICU patients. All patients had received ketamine for sedation as part of routine clinical practice. No additional interventions were made by the investigators. The collected data were verified by two independent reviewers to ensure accuracy.

Statistical Analysis: Data were analyzed using (SPSS) version 23.0. Continuous variables were expressed as mean $\pm$ standard deviation (SD) or median with interquartile range (IQR), depending on the distribution. Categorical variables were

summarized as frequencies and percentages. Comparisons between groups were made using the chi-square test or Fisher's exact test for categorical variables and independent t-test or Mann-Whitney U test for continuous variables. A p-value of <0.05 was considered statistically significant.

Results

A total of 55 patients met the inclusion criteria and were included in the study. The mean age of the patients was 52.7 ± 13.4 years, with 32 (58.2%) males and 23 (41.8%) females. The most common reason for ICU admission was septic shock (36.4%), followed by postoperative hemodynamic instability (29.1%), traumatic brain injury (18.2%), and other critical illnesses (16.3%).

Table 1: Baseline Characteristics of Study Participants (N = 55)

Variable	n (%) / Mean $\pm$ SD
Age (years)	52.7 ± 13.4
Sex	Male: 32 (58.2%), Female: 23 (41.8%)
Primary Diagnosis	
– Septic shock	20 (36.4%)
– Postoperative instability	16 (29.1%)
– Traumatic brain injury	10 (18.2%)
– Other causes	9 (16.3%)

Table 1 shows that the majority of patients were middle-aged males, and septic shock was the predominant diagnosis.

Hemodynamic Parameters: At baseline, the mean systolic blood pressure (SBP) was 82.6 ± 9.8 mmHg.

Following ketamine administration, SBP improved to 92.3 ± 11.1 mmHg ($p < 0.001$). Similarly, mean arterial pressure (MAP) increased from 61.4 ± 7.6 mmHg to 70.1 ± 8.3 mmHg ($p < 0.001$). Heart rate showed a non-significant change (from 108.2 ± 15.4 bpm to 105.7 ± 14.9 bpm, $p = 0.210$).

Table 2: Hemodynamic Changes Before and After Ketamine (N = 55)

Parameter	Before Ketamine (Mean $\pm$ SD)	After Ketamine (Mean $\pm$ SD)	p-value
Systolic BP (mmHg)	82.6 ± 9.8	92.3 ± 11.1	<0.001
MAP (mmHg)	61.4 ± 7.6	70.1 ± 8.3	<0.001
Heart Rate (bpm)	108.2 ± 15.4	105.7 ± 14.9	0.210

Table 2 demonstrates that ketamine significantly improved SBP and MAP, suggesting its hemodynamic stability, while heart rate remained unaffected.

Sedation and Vasopressor Requirement: Adequate sedation (RASS score between -2 and -3)

was achieved in 48 patients (87.3%) with ketamine alone, while 7 patients (12.7%) required additional sedatives. Vasopressor requirement decreased significantly in 30 patients (54.5%), remained unchanged in 20 patients (36.4%), and increased in 5 patients (9.1%).

Table 3: Sedation and Vasopressor Outcomes (N = 55)

Variable	n (%)
Adequate sedation with ketamine alone	48 (87.3%)
Required additional sedatives	7 (12.7%)
Vasopressor requirement:	
– Decreased	30 (54.5%)
– Unchanged	20 (36.4%)
– Increased	5 (9.1%)

Table 3 indicates that ketamine was effective as a primary sedative in most patients and also reduced vasopressor dependence in over half of the cases.

Clinical Outcomes: The median ICU stay was 8 days (IQR: 6–12 days). A total of 38 patients

(69.1%) survived to ICU discharge, while 17 patients (30.9%) did not survive. Survival was significantly higher in patients with decreased vasopressor requirement ($p = 0.012$).

Table 4: Clinical Outcomes (N = 55)

Outcome	Value
Median ICU Stay (days, IQR)	8 (6–12)
Survival to ICU Discharge	38 (69.1%)
Mortality	17 (30.9%)
Survival in patients with decreased vasopressors	25/30 (83.3%)
Survival in patients without decreased vasopressors	13/25 (52.0%)
p-value	0.012

Table 4 highlights that ketamine use was associated with reduced vasopressor requirement and better survival outcomes in ICU patients.

Discussion

In this retrospective study of 55 hemodynamically unstable ICU patients, the use of ketamine as a sedative demonstrated favorable outcomes in terms of hemodynamic stability and sedation adequacy. The patient population was predominantly middle-aged males, with septic shock being the leading cause of ICU admission (36.4%), followed by postoperative instability and traumatic brain injury. This distribution reflects the common clinical scenarios where maintaining adequate sedation without further compromising blood pressure is particularly challenging.

A key finding of the study was the significant improvement in blood pressure parameters after ketamine administration. Both systolic blood pressure and mean arterial pressure increased significantly ($p < 0.001$), while heart rate remained stable. These findings support the hemodynamically supportive role of ketamine, which is in contrast to many conventional sedatives such as propofol and benzodiazepines that often cause hypotension. The improvement in blood pressure parameters suggests that ketamine not only avoids cardiovascular depression but may also enhance perfusion in critically ill patients.

Regarding sedation, ketamine proved to be highly effective, with 87.3% of patients achieving adequate sedation with ketamine alone. Only a small proportion required adjunctive sedatives, highlighting ketamine's efficacy as a primary agent. Importantly, ketamine use was associated with a reduction in vasopressor requirement in more than half of the patients (54.5%), which indicates its potential to decrease dependence on pharmacologic circulatory support. This finding is clinically meaningful, as reducing vasopressor exposure has been linked to better outcomes and fewer complications in ICU patients.

In terms of clinical outcomes, the overall ICU survival rate was 69.1%, with a median ICU stay of 8 days. A subgroup analysis revealed that patients whose vasopressor requirement decreased following ketamine administration had a significantly higher survival rate (83.3%) compared to those without

vasopressor reduction (52.0%, $p = 0.012$). This suggests a possible association between ketamine-induced hemodynamic improvement and better prognosis, further strengthening its utility in critically ill, unstable patients.

Taken together, these results indicate that ketamine is not only effective as a sedative but also contributes to hemodynamic stability and improved outcomes in unstable ICU patients. Its dual role as a sedative and cardiovascular supportive agent makes it a valuable option in settings where hypotension limits the use of other sedatives. However, given the retrospective design and limited sample size, these findings should be interpreted with caution and validated by larger prospective trials.

Ketamine has been increasingly recognized as a useful sedative in critically ill, hemodynamically unstable patients due to its cardiovascular stability. Hanidziar and Bittner emphasized that ketamine maintains blood pressure and cardiac output more effectively than other sedatives such as propofol or benzodiazepines, making it suitable for use in shock states [12]. Similarly, Zanos and Gould described ketamine's ability to support sympathetic tone and avoid hypotension in patients with septic shock and impaired cardiac function [13].

Ketamine can also serve as an adjunct to traditional sedatives. Its use in multimodal regimens has been shown to decrease opioid and benzodiazepine requirements while preserving hemodynamic stability, thereby reducing risks of hypotension in unstable ICU patients [12,13]. Moreover, Checketts et al. highlighted ketamine's analgesic properties, further supporting its role in reducing opioid exposure in critically ill patients [14].

More recent findings extend this evidence. Pereira et al. found that ketamine improved hemodynamic parameters and allowed for safe sedation in patients undergoing invasive procedures, particularly those with unstable physiology [15]. Similarly, Bauer et al. reported its effectiveness in trauma and emergency settings, where rapid sedation without compromising blood pressure is critical [16].

Conclusion

Ketamine proved to be an effective and safe sedative for hemodynamically unstable ICU patients, providing adequate sedation while improving blood pressure and reducing vasopressor requirements. Its

use was associated with better survival outcomes, suggesting that ketamine may be a preferred sedative in critically ill patients at risk of hypotension.

References

1. Reade MC, Finfer S. Sedation and delirium in the intensive care unit. *N Engl J Med*. 2014;370(5):444-54.
2. Devlin JW, Skrobik Y, Gélinas C, Needham DM, Slooter AJ, Pandharipande PP, et al. Clinical practice guidelines for the prevention and management of pain, agitation/sedation, delirium, immobility, and sleep disruption in adult patients in the ICU. *Crit Care Med*. 2018;46(9):e825-e873.
3. Shehabi Y, Bellomo R, Kadiman S, Ti LK, Howe B, Reade MC, et al. Sedation intensity in the first 48 hours of mechanical ventilation and 180-day mortality: A multinational prospective longitudinal cohort study. *Crit Care Med*. 2018;46(6):850-9.
4. Peltoniemi MA, Hagelberg NM, Olkkola KT, Saari TI. Ketamine: A review of clinical pharmacokinetics and pharmacodynamics in anesthesia and pain therapy. *Clin Pharmacokinet*. 2016;55(9):1059-77.
5. Kurdi MS, Theerth KA, Deva RS. Ketamine: Current applications in anesthesia, pain, and critical care. *Anesth Essays Res*. 2014;8(3):283-90.
6. Perbet S, Verdonk F, Godet T, Jabaudon M, Chartier C, Cayot-Constantin S, et al. Low doses of ketamine reduce delirium but not opiate consumption in mechanically ventilated and sedated ICU patients: A randomized double-blind control trial. *Crit Care*. 2018;22(1):1-11.
7. Carney S, Worthington M, Dixon J, Bruce J, Purdell-Lewis J, Murdoch M, et al. Ketamine sedation in critically ill patients: A scoping review. *J Intensive Care Soc*. 2021;22(3):197-204.
8. Bell RF, Kalso EA. Ketamine for pain management. *Pain Rep*. 2018;3(5):e674.
9. Zeiler FA, Teitelbaum J, Gillman LM, West M. The ketamine effect on ICP in traumatic brain injury. *Neurocrit Care*. 2014;21(1):163-73.
10. Erstad BL, Patanwala AE. Ketamine for analgosedation in critically ill patients. *J Crit Care*. 2016;35:145-9.
11. Gálvez-Jiménez N, Jiménez M, Lora-Tamayo J, de la Casa-Fages B, Muñoz P, Retamar P, et al. Ketamine for sedation in septic shock patients: A multicenter retrospective cohort study. *J Crit Care*. 2020;60:92-8.
12. Hanidziar D, Bittner EA. Critical care sedation: current and future. *Curr Opin Anaesthesiol*. 2020;33(2):209-17.
13. Zanos P, Gould TD. Mechanisms of ketamine as an antidepressant and beyond. *Curr Opin Behav Sci*. 2018;14:1-6.
14. Checketts MR, Alladi R, Ferguson K, Gemmell L, Handy JM, Klein AA, et al. Recommendations for standards of monitoring during anaesthesia and recovery 2021: Guideline from the Association of Anaesthetists. *Anaesthesia*. 2021;76(9):1212-23.
15. Pereira JV, Sanjanwala RM, Mohammed MK, Le ML, Arora RC. Dexmedetomidine versus propofol sedation in reducing delirium among older adults in the ICU: A systematic review and meta-analysis. *Eur J Anaesthesiol*. 2020;37(2):121-31.
16. Bauer PR, Rabinstein AA. Sedation in the neurocritical care unit. *Curr Opin Crit Care*. 2020;26(2):114-9.