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Original Research Article

Real-World Comparative Effectiveness of Dexmedetomidine vs. Propofol for ICU Sedation in Indian Teaching Hospitals

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Abstract:

Background: Sedation is an essential component of intensive care unit (ICU) management for mechanically ventilated patients. Appropriate sedation improves patient comfort, facilitates ventilator synchrony, and reduces the risk of agitation-related complications. Among sedative agents, Dexmedetomidine and Propofol are widely used due to their rapid onset and favorable pharmacological properties.

Aim: To compare the real-world effectiveness and safety of dexmedetomidine versus propofol for ICU sedation in an Indian teaching hospital.

Methods: A prospective observational comparative study was conducted in the ICU of Nalanda Medical College and Hospital, Patna, India. Twenty-five mechanically ventilated adult patients requiring continuous sedation were included over a 9-month period (March 2025–December 2025). Patients received either dexmedetomidine (n=13) or propofol (n=12). Sedation quality, hemodynamic parameters, duration of mechanical ventilation, ICU stay, and adverse effects were analyzed statistically.

Results: Dexmedetomidine achieved significantly better sedation stability and shorter mechanical ventilation duration compared with propofol ($p<0.05$). ICU length of stay was also shorter in the dexmedetomidine group. Bradycardia was observed more frequently in patients receiving dexmedetomidine.

Conclusion: Dexmedetomidine provided improved sedation quality and better clinical outcomes compared with propofol for ICU sedation.

Keywords: Dexmedetomidine, Propofol, ICU sedation, Mechanical ventilation, Critical care.

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Introduction

Sedation plays a fundamental role in the management of critically ill patients admitted to intensive care units (ICUs). Appropriate sedation improves patient comfort, reduces anxiety, and facilitates mechanical ventilation and invasive procedures. [1]

Patients receiving mechanical ventilation frequently require continuous sedative infusions to maintain synchrony with the ventilator and to prevent accidental removal of medical devices. [2]

However, excessive sedation may delay extubation, prolong ICU stay, and increase healthcare costs. Therefore, the selection of an appropriate sedative agent is an important determinant of clinical outcomes. [3]

Among currently available sedatives, **Dexmedetomidine** and **Propofol** are commonly used in critical care practice due to their rapid onset and ease of titration. [4]

Dexmedetomidine is a highly selective α2-adrenergic receptor agonist that produces cooperative sedation resembling physiologic sleep without causing significant respiratory depression. [5]

This drug also possesses analgesic and sympatholytic properties, making it particularly useful for critically ill patients who require prolonged sedation. [6]

In contrast, propofol is a short-acting intravenous hypnotic agent that produces sedation primarily by enhancing gamma-aminobutyric acid (GABA) mediated inhibitory neurotransmission in the central nervous system. [7]

Propofol is widely used in ICU settings because of its rapid onset and short recovery time, allowing easy adjustment of sedation depth. [8]

Several randomized clinical trials have evaluated the effectiveness of dexmedetomidine compared with traditional sedatives in mechanically ventilated patients. [9]

These studies suggest that dexmedetomidine may reduce the duration of mechanical ventilation and improve communication between patients and healthcare providers. [10]

Furthermore, dexmedetomidine-based sedation has been associated with a lower incidence of delirium in ICU patients. [11]

Despite its advantages, dexmedetomidine may cause adverse cardiovascular effects such as bradycardia and hypotension due to its sympatholytic action. [12]

Clinical practice guidelines increasingly recommend lighter sedation strategies using sedatives that allow patients to remain arousable and cooperative. [13]

Although multiple international studies have compared these sedative agents, real-world data from Indian teaching hospitals remain limited. [14]

Therefore, the present study was conducted to compare the real-world effectiveness and safety of dexmedetomidine and propofol for ICU sedation in a tertiary-care teaching hospital in India.

Materials and Methods

Study Design: This study was conducted as a prospective observational comparative study designed to evaluate the real-world clinical effectiveness and safety of dexmedetomidine versus propofol for sedation in mechanically ventilated intensive care unit (ICU) patients.

Study Setting: The study was carried out in the Intensive Care Unit of Nalanda Medical College and Hospital (NMCH), Patna, Bihar, India, which is a tertiary-care government teaching hospital that manages critically ill patients from both urban and rural regions.

Study Duration: Patient recruitment and data collection were conducted over a 9-month period from March 2025 to December 2025.

Study Population: A total of 25 adult patients admitted to the ICU who required mechanical ventilation and continuous intravenous sedation were included in the study.

Eligible patients were screened consecutively during the study period. Patients who fulfilled the inclusion criteria and did not meet any exclusion criteria were enrolled.

The study population was divided into two groups based on the sedative agent administered as part of routine ICU care.

- **Group A:** Dexmedetomidine group (n = 13)
- **Group B:** Propofol group (n = 12)

Sedative selection was made by the treating intensivist according to institutional sedation protocols and patient clinical condition.

Inclusion Criteria

Patients were included in the study if they fulfilled the following criteria:

- Age 18 years or older.
- Patients requiring mechanical ventilation.
- Requirement of continuous intravenous sedation for more than 24 hours.
- Hemodynamically stable at the time of sedation initiation.
- ICU admission requiring ventilatory support for medical or surgical indications.

Exclusion Criteria

Patients were excluded if they had:

- Severe hepatic failure
- Advanced atrioventricular heart block without pacemaker support
- Known hypersensitivity to dexmedetomidine or propofol
- Pregnancy
- Pre-existing severe neurological impairment interfering with sedation assessment
- Patients expected to require mechanical ventilation for less than 24 hours

Sedation Protocol: Sedation was administered using standard ICU infusion pumps with continuous monitoring.

Dexmedetomidine Group: Patients assigned to the dexmedetomidine group received continuous intravenous dexmedetomidine infusion at a dose ranging from 0.2–0.7 µg/kg/hour.

Loading doses were generally avoided in order to minimize the risk of sudden hemodynamic instability. The infusion rate was titrated according to the target sedation level and patient response.

Propofol Group: Patients in the propofol group received continuous intravenous propofol infusion at a dose of 1–3 mg/kg/hour, titrated to achieve the desired level of sedation.

Infusion rates were adjusted periodically based on the patient's sedation score and clinical requirements.

Sedation Monitoring: Sedation depth was assessed using the Richmond Agitation Sedation Scale

(RASS), a validated tool commonly used in ICU sedation monitoring.

The target RASS range was maintained between −2 and 0, corresponding to light to moderate sedation where patients remain calm but arousable.

Sedation levels were recorded at regular intervals by ICU nursing staff and supervising clinicians. The percentage of time patients remained within the target RASS range during the sedation period was calculated to determine sedation stability.

Data Collection: Clinical and demographic data were recorded using structured case record forms.

The following variables were documented:

Baseline Clinical Variables

- Age.
- Sex.
- Primary diagnosis requiring ICU admission.
- Severity of illness measured by APACHE II score.

Sedation-Related Variables

- Type of sedative used
- Infusion dosage
- Sedation depth (RASS score)
- Percentage of time within target sedation range

Clinical Outcome Variables

The primary outcomes evaluated were:

1. Sedation stability Defined as the percentage of time the patient remained within the target RASS range.
2. Duration of mechanical ventilation Measured in hours from initiation of ventilation until successful extubation.

Secondary Outcome Variables

Secondary outcomes included:

- Length of ICU stay (days).
- Hemodynamic changes, including heart rate and blood pressure.
- Adverse events associated with sedative administration.

Adverse Effects

The following complications were specifically monitored:

- Bradycardia, defined as heart rate <50 beats/min.
- Hypotension, defined as systolic blood pressure <90 mmHg.
- Agitation episodes, defined as RASS score ≥ +2 requiring intervention.

Adverse events were recorded during the sedation period and managed according to standard ICU protocols.

Sample Size: The study included 25 patients, representing all eligible patients admitted during the study period who met inclusion criteria. The sample size was determined based on the feasibility of patient recruitment within the specified study duration.

Statistical Analysis: All collected data were entered into a spreadsheet and analyzed using Statistical Package for the Social Sciences (SPSS) version 25.0.

Data Presentation

- Continuous variables were expressed as mean ± standard deviation (SD).
- Categorical variables were presented as frequency and percentage.

Statistical Tests

The following statistical tests were applied:

1. Independent sample t-test to compare continuous variables between groups (e.g., ventilation duration, ICU stay, sedation stability)
2. Chi-square test to analyze categorical variables such as sex distribution and adverse events.

A p-value less than 0.05 was considered statistically significant.

Ethical Considerations: The study was conducted in accordance with the ethical principles of biomedical research involving human subjects.

Approval for the study protocol was obtained from the Institutional Ethics Committee of Nalanda Medical College and Hospital, Patna prior to initiation of the study.

Patient confidentiality was strictly maintained, and all collected data were anonymized before analysis.

Because the study was observational and sedation was administered as part of routine ICU care, no additional interventions were imposed on patients.

Results

A total of 25 mechanically ventilated ICU patients were included in the study. Of these, 13 patients received dexmedetomidine (Group A) and 12 patients received propofol (Group B) for continuous sedation during mechanical ventilation.

Baseline Characteristics: The demographic and clinical characteristics of the study population are presented in Table 1. The mean age of patients in the dexmedetomidine group was 54.2 ± 9.3 years, while that of the propofol group was 55.1 ± 10.1 years.

There was no statistically significant difference in age distribution between the two groups (p = 0.82).

Male patients constituted 61.5% of the dexmedetomidine group and 58.3% of the propofol group. The severity of illness assessed using the APACHE II score was comparable between groups (18.1 ± 3.4 vs 17.8 ± 3.7; p = 0.79).

These findings indicate that both groups were clinically comparable at baseline, allowing reliable comparison of outcomes (Table 1).

Table 1 Baseline Demographic and Clinical Characteristics

Variable	Dexmedetomidine (n=13)	Propofol (n=12)	p-value
Age (years)	54.2 ± 9.3	55.1 ± 10.1	0.82
Male (%)	8 (61.5%)	7 (58.3%)	0.87
Female (%)	5 (38.5%)	5 (41.7%)	0.87
APACHE II Score	18.1 ± 3.4	17.8 ± 3.7	0.79

Sedation Stability: Sedation quality was assessed using the percentage of time patients remained within the target Richmond Agitation Sedation Scale (RASS) range.

Patients receiving dexmedetomidine remained within the target sedation range for 84 ± 9% of the monitoring period, whereas those receiving propofol remained within the target range for 68 ± 11% of the time.

The difference between the two groups was statistically significant (t = 3.04, p = 0.01), indicating that dexmedetomidine provided more consistent and stable sedation compared with propofol.

These results are summarized in Table 2, while the graphical comparison is illustrated in Figure 1.

Table 2: Sedation Stability

Parameter	Dexmedetomidine	Propofol	p-value
Time within target RASS (%)	84 ± 9	68 ± 11	0.01

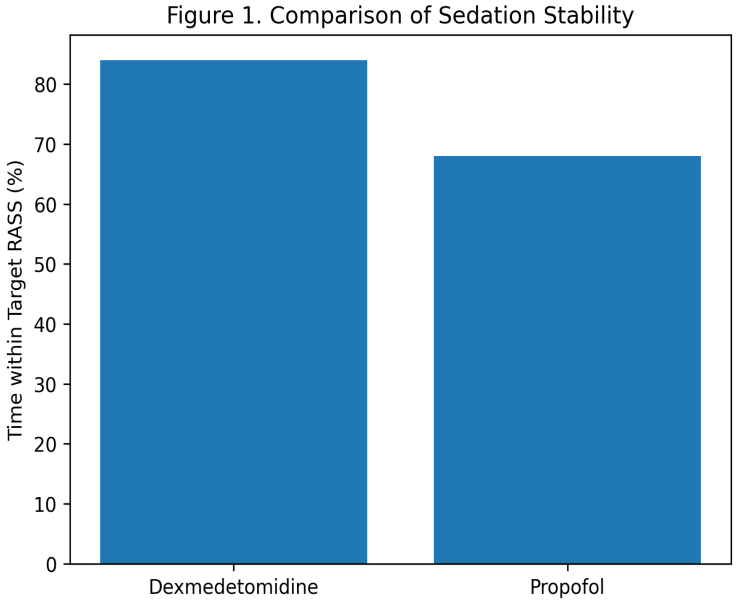

Figure 1. Comparison of Sedation Stability

Duration of Mechanical Ventilation: The duration of mechanical ventilation was significantly shorter among patients receiving dexmedetomidine.

The mean ventilation duration was 42.5 ± 10.2 hours in the dexmedetomidine group compared with 55.8 ± 12.7 hours in the propofol group.

Statistical analysis using an independent t-test revealed a significant reduction in ventilation duration among dexmedetomidine-treated patients (t = 2.98, p = 0.007).

These findings are presented in Table 3 and graphically illustrated in Figure 2.

Table 3: Duration of Mechanical Ventilation

Group	Mean Duration (hours)
Dexmedetomidine	42.5 ± 10.2
Propofol	55.8 ± 12.7

t = 2.98

p = 0.007

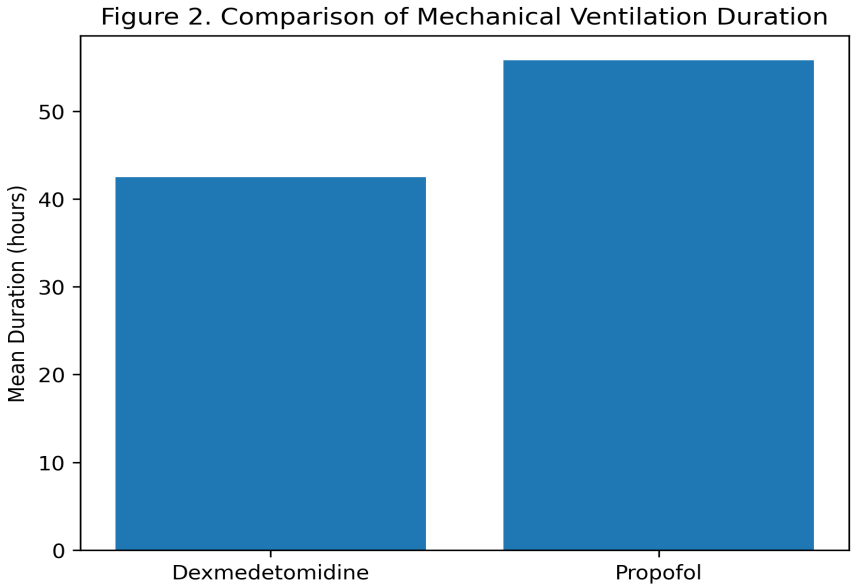

Figure 2: Comparison of Mechanical Ventilation Duration

ICU Length of Stay: The mean ICU stay was also shorter in patients receiving dexmedetomidine.

Patients in the dexmedetomidine group had an average ICU stay of 5.8 ± 1.6 days, whereas the propofol group had an average stay of 7.2 ± 2.1 days.

The difference between the groups was statistically significant (t = 2.15, p = 0.04).

These results are summarized in Table 4.

Table 4: ICU Length of Stay

Group	Mean ICU Stay (days)
Dexmedetomidine	5.8 ± 1.6
Propofol	7.2 ± 2.1

t = 2.15

p = 0.04

Adverse Effects: Adverse events observed during the study are summarized in Table 5.

Bradycardia occurred in 3 patients (23.1%) in the dexmedetomidine group, whereas no cases were reported in the propofol group. This difference was statistically significant ($\chi^2 = 4.17$, p = 0.04).

Hypotension occurred in 2 patients receiving dexmedetomidine and 3 patients receiving propofol, but the difference was not statistically significant (p = 0.61).

Episodes of agitation were more common in the propofol group (4 patients) compared with the dexmedetomidine group (1 patient), with borderline statistical significance (p = 0.05).

Table 5: Adverse Events

Event	Dexmedetomidine (n=13)	Propofol (n=12)	p-value
Bradycardia	3	0	0.04
Hypotension	2	3	0.61
Agitation	1	4	0.05

Summary of Major Findings

The present study demonstrated that:

- Dexmedetomidine provided significantly better sedation stability compared with propofol.

- The duration of mechanical ventilation was significantly shorter in patients receiving dexmedetomidine.
- Dexmedetomidine was associated with a shorter ICU stay.
- Bradycardia was more frequently observed with dexmedetomidine, whereas agitation was more common with propofol.

Overall, these findings suggest that dexmedetomidine offers more stable sedation and improved clinical outcomes in mechanically ventilated ICU patients compared with propofol.

Discussion

Effective sedation strategies are essential to optimize outcomes in critically ill patients requiring mechanical ventilation. The present study compared dexmedetomidine and propofol for ICU sedation in a real-world clinical setting.

The results demonstrated significantly better sedation stability with dexmedetomidine compared with propofol. Similar findings were reported in randomized clinical trials evaluating dexmedetomidine-based sedation strategies. [15]

Dexmedetomidine produces sedation through activation of central α2-adrenergic receptors, leading to inhibition of norepinephrine release in the locus coeruleus. [16]

This mechanism produces sedation resembling natural sleep while maintaining respiratory drive.

Our study also showed that dexmedetomidine significantly reduced the duration of mechanical ventilation. Comparable results have been reported in multicenter trials involving critically ill patients. [17]

Reduced ventilation duration is clinically important because prolonged ventilation increases the risk of ventilator-associated pneumonia and other complications.

Patients receiving dexmedetomidine also experienced shorter ICU stays. Previous observational studies have reported similar improvements in ICU outcomes with dexmedetomidine-based sedation protocols. [18]

However, dexmedetomidine was associated with a higher incidence of bradycardia in this study. This adverse effect has been consistently reported in pharmacologic studies of α2-adrenergic agonists. [19]

Propofol remains a widely used sedative agent in ICU practice because of its rapid onset and short context-sensitive half-life. [20]

Despite these advantages, propofol infusion may cause hypotension and metabolic complications during prolonged administration. [21]

Current international sedation guidelines emphasize maintaining lighter sedation levels whenever feasible. [22]

Meta-analyses comparing dexmedetomidine with other sedatives have demonstrated improved clinical outcomes including reduced delirium and earlier extubation. [23]

Sedation management also influences the risk of ICU delirium, which is associated with increased mortality and prolonged hospitalization. [24]

Therefore, individualized sedation protocols are necessary to balance adequate sedation with early mobilization and neurological assessment. [25]

Conclusion

Dexmedetomidine demonstrated superior sedation stability compared with propofol, while also contributing to a shorter duration of mechanical ventilation and a reduced length of stay in the intensive care unit. Although a higher incidence of bradycardia was observed among patients receiving dexmedetomidine, the overall clinical outcomes were more favorable in this group. These results suggest that dexmedetomidine is an effective and reliable sedative agent for critically ill patients requiring mechanical ventilation in the ICU and may offer clinical advantages over propofol in terms of sedation quality and recovery-related outcomes.

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