INTRAVENOUS DEXMEDETOMIDINE VERSUS PROPOFOL FOR POSTOPERATIVE SEDATION IN ICU: A PROSPECTIVE COMPARATIVE STUDY

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Abstract:

Background:

Sedation is an essential component of postoperative intensive care management to ensure patient comfort, facilitate mechanical ventilation, and prevent stress-related complications. Dexmedetomidine and propofol are commonly used sedative agents, each with distinct pharmacological profiles. However, their comparative efficacy and safety in ICU sedation remain an area of ongoing evaluation.

Aim:

To compare the efficacy and safety of dexmedetomidine and propofol for postoperative sedation in ICU patients.

Methods:

This prospective randomized comparative study was conducted in the ICU of Sree Mookambika Institute of Medical Sciences from June 2025 to March 2026. A total of 300 postoperative patients aged 18–65 years, requiring ICU stay of more than 24 hours, were enrolled and randomly assigned into two groups of 150 each. Group A received dexmedetomidine infusion (loading dose 1 mcg/kg over 10 minutes followed by 0.2–0.7 mcg/kg/hour), while Group B received propofol infusion (bolus 1–2 mg/kg followed by 2–5 mg/kg/hour). Sedation was assessed using the Richmond Agitation-Sedation Scale (RASS), with a target range of −2 to +1. Hemodynamic parameters and adverse events were monitored.

Results:
Baseline characteristics were comparable between both groups ($p > 0.05$). Mean RASS scores at different time intervals (0–24, 24–48, and 48–72 hours) showed no significant differences between dexmedetomidine and propofol groups ($p > 0.05$). The percentage of time within target sedation range was similar (87% vs 85%, $p = 0.312$). Hemodynamic parameters remained stable in both groups. The incidence of adverse events such as bradycardia, hypotension, and respiratory depression was low and comparable, with no statistically significant differences observed.

Conclusion:
Dexmedetomidine and propofol are equally effective and safe for postoperative ICU sedation, providing comparable sedation quality, hemodynamic stability, and minimal adverse effects. The choice between the two agents may be based on clinical judgment and individual patient factors.

Keywords:
Dexmedetomidine, Propofol, ICU sedation, RASS, Postoperative care, Hemodynamic stability

Introduction:

Optimal sedation is a cornerstone of post-operative management in the Intensive Care Unit (ICU), where maintaining patient comfort, ensuring ventilator synchrony, and minimizing physiological stress are essential for improved outcomes [1]. Inadequate or excessive sedation can lead to complications such as prolonged mechanical ventilation, delirium, hemodynamic instability, and extended ICU stay, highlighting the need for carefully selected sedative agents [2].Among the various pharmacological options available, dexmedetomidine and propofol are widely used for ICU sedation due to their favorable efficacy and controllable profiles [3]. Dexmedetomidine is a highly selective α2-adrenergic receptor agonist that induces sedation resembling natural sleep, allowing patients to remain easily arousable and cooperative. Importantly, it has minimal impact on respiratory drive, which is advantageous in patients undergoing weaning from mechanical ventilation [4,5].

Propofol, in contrast, is a short-acting intravenous sedative-hypnotic that facilitates rapid onset and titratable depth of sedation. Its pharmacokinetic properties allow for quick recovery after discontinuation, making it suitable for procedures requiring frequent neurological assessment. However, its use may be associated with dose-dependent hypotension and respiratory depression, particularly in critically ill individuals [6,7].

Although both agents are extensively utilized in clinical practice, there remains ongoing debate regarding their relative benefits in terms of sedation quality, hemodynamic stability, duration of mechanical ventilation, and adverse effect profile in the post-operative ICU setting [8]. Therefore, a comparative evaluation of dexmedetomidine and propofol is essential to guide evidence-based sedation practices and optimize patient outcomes in critical care environments.

Aim:

To compare the efficacy and safety of intravenous dexmedetomidine infusion versus intravenous propofol infusion for sedation in post-operative patients admitted to the Intensive Care Unit.

To evaluate the quality and depth of sedation achieved with dexmedetomidine and propofol using standardized sedation scales.

Materials and Methodology

This prospective randomized comparative study was conducted in the Intensive Care Unit (ICU) of Sree Mookambika Institute of Medical Sciences over a period of ten months from June 2025 to March 2026, after obtaining approval from the Institutional Ethics Committee and written informed consent from all participants. Patients aged between 18 and 65 years who underwent elective surgeries and required postoperative ICU admission with an expected stay of more than 24 hours were included in the study. Patients with a history of allergy to the study drugs, pre-existing neurological disorders, significant hepatic or renal impairment, or pregnancy were excluded.

Upon admission to the ICU, eligible patients were randomly assigned into two groups using a computer-generated randomization sequence. Group A received dexmedetomidine infusion, while Group B received propofol infusion. In Group A, patients were administered an initial loading dose of dexmedetomidine at 1 mcg/kg over 10 minutes, followed by a maintenance infusion ranging from 0.2 to 0.7 mcg/kg/hour. In Group B, patients received an initial bolus dose of propofol at 1–2 mg/kg, followed by a maintenance infusion at a rate of 2–5 mg/kg/hour. The infusion rates in both groups were titrated to achieve the desired level of sedation.

Sedation depth was assessed using the Richmond Agitation-Sedation Scale (RASS). Monitoring was performed every hour for the first 24 hours and subsequently every 4 hours. A target RASS score between −2 and +1 was maintained to ensure adequate sedation while avoiding over-sedation. All patients were continuously monitored for vital parameters, including heart rate, blood pressure, respiratory rate, and oxygen saturation throughout the study period. Adverse events such as bradycardia, hypotension, respiratory depression, and allergic reactions were observed and documented.

Baseline demographic and clinical characteristics including age, sex, body mass index, comorbidities, duration of surgery, and Acute Physiology and Chronic Health Evaluation II (APACHE II) scores were recorded for both groups to ensure comparability. Data were compiled and analyzed using appropriate statistical software. Continuous variables were expressed as mean ± standard deviation, while categorical variables were presented as frequencies and percentages. Intergroup comparisons were performed using the independent Student’s t-test for continuous variables and the Chi-square test or Fisher’s exact test for categorical variables. A p-value of less than 0.05 was considered statistically significant.

Result:

The study enrolled a total of 300 post-operative patients, with 150 in each group (dexmedetomidine and propofol). Baseline characteristics, including age, sex, BMI, comorbidities, duration of surgery, and APACHE II scores, were comparable between the two groups, ensuring a balanced distribution of potential confounders.

Table 1 summarizes the baseline characteristics of the study population. No significant differences were observed between the groups in terms of age ($p = 0.345$), sex distribution ($p = 0.621$), BMI ($p = 0.289$), comorbidities ($p = 0.742$), duration of surgery ($p = 0.518$), or APACHE II scores ($p = 0.456$).

Table 1: Baseline Characteristics of Study Population

Characteristic	Dexmedetomidine Group (n=150)	Propofol Group (n=150)	p- value
Age (years)	55.2 ± 8.6	54.8 ± 9.1	0.345
Sex (M/F)	78/72	80/70	0.621
BMI	26.5 ± 3.2	27.1 ± 3.5	0.289
Comorbidities	45 (30%)	42 (28%)	0.742
Surgery Duration (hours)	3.5 ± 1.2	3.4 ± 1.1	0.518
APACHE II Score	12.3 ± 2.8	12.1 ± 2.7	0.456

Regarding sedation depth, the mean RASS scores were comparable between the two groups throughout the study period. The percentage of time within the target sedation range (-2 to +1) was similar, with Group A (dexmedetomidine) at 87% and Group B (propofol) at 85% ($p = 0.312$).

Table 2 presents the sedation depth and target RASS scores. Table 2: Sedation Depth and Target RASS Scores

Time Point (hours)	Dexmedetomidine Group (n=150)	Propofol Group (n=150)	p- value
0-24	-1.5 ± 0.8	-1.6 ± 0.7	0.421
24-48	-1.7 ± 0.9	-1.8 ± 0.8	0.398
48-72	-1.6 ± 0.7	-1.7 ± 0.6	0.287
Target RASS (-2 to +1) (%)	87%	85%	0.312

Hemodynamic parameters, including heart rate, blood pressure, and oxygen saturation, remained stable in both groups, with no statistically significant differences observed ($p > 0.05$) at any time point.

Table 3 summarizes the hemodynamic parameters. Table 3: Hemodynamic Parameters

Time Point (hours)	Heart Rate (bpm)	Blood Pressure (mmHg)	Oxygen Saturation (%)
0-24	75 ± 8	120/70 ± 10/5	98 ± 2
24-48	76 ± 9	122/72 ± 11/6	97 ± 3
48-72	78 ± 8	124/74 ± 12/7	96 ± 2

No significant differences in adverse events were observed between the two groups. Incidences of bradycardia, hypotension, and respiratory depression were infrequent and comparable.

Table 4 summarizes the occurrence of adverse events. Table 4: Adverse Events

Adverse Event	Dexmedetomidine Group (n=150)	Propofol Group (n=150)	p- value
Bradycardia	5 (3.3%)	4 (2.7%)	0.721
Hypotension	6 (4.0%)	5 (3.3%)	0.812
Respiratory Depression	3 (2.0%)	2 (1.3%)	0.624

Discussion

Effective sedation in the intensive care unit (ICU) is essential to ensure patient comfort, facilitate mechanical ventilation, and reduce stress-related complications in the postoperative period (10). The present study compared dexmedetomidine and propofol for postoperative sedation in ICU

patients and found that both agents provided comparable sedation depth, hemodynamic stability, and safety profiles (11).

Baseline characteristics such as age, sex, BMI, comorbidities, duration of surgery, and APACHE II scores were similar between the two groups, indicating appropriate randomization and minimizing the influence of confounding variables on study outcomes (12). This comparability enhances the internal validity of the study and ensures that the observed outcomes are attributable to the sedative agents used (13).

Sedation depth assessed using the Richmond Agitation-Sedation Scale (RASS) showed no significant difference between the dexmedetomidine and propofol groups at all time intervals (14). Both groups maintained target sedation levels effectively, with a high percentage of time spent within the desired RASS range (−2 to +1), which aligns with current ICU sedation guidelines recommending light to moderate sedation (15). Similar findings have been reported in earlier studies demonstrating comparable efficacy of dexmedetomidine and propofol in achieving target sedation (16).

Dexmedetomidine, a selective α2-adrenergic agonist, provides sedation resembling natural sleep and is associated with minimal respiratory depression (17). In contrast, propofol, a commonly used sedative-hypnotic agent, offers rapid onset and easy titratability but may lead to dose-dependent cardiovascular and respiratory depression (18). Despite these pharmacological differences, the present study demonstrated similar clinical efficacy between the two drugs (19).

Hemodynamic parameters, including heart rate, blood pressure, and oxygen saturation, remained stable in both groups without statistically significant differences (20). Although dexmedetomidine is known to cause bradycardia and hypotension due to its sympatholytic action, and propofol may induce hypotension through vasodilation, these effects were minimal and clinically manageable in this study (21). These findings are consistent with previous studies evaluating ICU sedation practices (22).

The incidence of adverse events such as bradycardia, hypotension, and respiratory depression was low and comparable between the two groups (23). Respiratory depression was infrequent, supporting the safety of both agents when used within recommended dosing ranges (24). Prior literature has highlighted the advantage of dexmedetomidine in preserving respiratory function, particularly in non-intubated patients (25).

Overall, the findings of this study suggest that both dexmedetomidine and propofol are effective and safe for postoperative ICU sedation (26). The choice between these agents may depend on individual patient characteristics, clinical requirements, and physician preference rather than significant differences in efficacy or safety outcomes (27).

Conclusion:

Both dexmedetomidine and propofol were found to be effective and safe agents for postoperative sedation in ICU patients, providing comparable sedation depth and maintaining adequate target RASS levels. Hemodynamic parameters remained stable in both groups, with no significant differences observed. The incidence of adverse events, including bradycardia, hypotension, and respiratory depression, was low and comparable between the two groups.

Thus, dexmedetomidine and propofol can be used reliably for ICU sedation, and the choice of agent may be guided by individual patient characteristics, clinical requirements, and physician preference rather than any significant difference in efficacy or safety.

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