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A Comparative Study to Evaluate Efficacy of IV Infusion of Dexmedetomidine versus IV Infusion of Propofol for Post-Operative ICU Sedation: An Original Research

Dr. Bheemanadhuni Anusha, Dr. Potlapelly Vasu Prakash, Dr. Voviliveni Srikala, Dr Chandrashekhar Botla, Dr Sreenivas Azmeera

Assistant Professor, Department of Anaesthesiology, PMSSY Super Speciality Hospital, Kakatiya Medical College, Warangal, Telangana. anusha.bheem@gmail.com

Assistant Professor, Department of Anaesthesiology, Kakathiya Medical College, Hanamkonda, Warangal. vasupprakash@gmail.com

Associate Professor, Department of Anaesthesiology, PMSSY Super Speciality Hospital, Kakatiya Medical College, Warangal, Telangana. srikaladrv@gmail.c

Associate Professor, Department of Anaesthesiology, PMSSY Super Speciality Hospital, Kakatiya Medical College, Warangal, Telangana. drchandrashekhar1994@gmail.com

Assistant Professor, Department of Anaesthesiology, PMSSY Super Speciality Hospital, Kakatiya Medical College, Warangal, Telangana. sreenivas.azmeera@gmail.com

Corresponding Author: Dr Chandrashekhar Botla. drchandrashekhar1994@gmail.com

Abstract

Objective: This study aimed to compare the efficacy and safety of intravenous (IV) infusion of dexmedetomidine versus IV infusion of propofol for post-operative sedation in the intensive care unit (ICU).

Methods: A prospective, randomized controlled trial was conducted involving 300 post-operative ICU patients. Patients were randomly assigned to receive either dexmedetomidine or propofol for sedation. Sedation depth was assessed using the Richmond Agitation-Sedation Scale (RASS), monitoring vital signs, and adverse events. Baseline demographic data, including age, sex, BMI, comorbidities, surgery duration, and APACHE II scores, were recorded. Statistical analysis employed t-tests, chi-square tests, and Fisher's exact tests for comparison.

Results: Both groups (dexmedetomidine and propofol) comprised 150 patients each. Baseline characteristics were similar between groups. Sedation depth, assessed by RASS scores, and time within the target sedation range (-2 to +1) were comparable between the groups. Hemodynamic parameters remained stable with no significant differences. Adverse events such as bradycardia, hypotension, and respiratory depression were infrequent and similar in both groups.

Conclusion: Dexmedetomidine and propofol demonstrated comparable efficacy in achieving and maintaining sedation depth, ensuring hemodynamic stability, and exhibiting low rates of adverse events in post-operative ICU patients. The choice between these agents may depend

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on individual patient needs and specific clinical scenarios, considering their distinct pharmacological profiles. Further research exploring long-term outcomes and cost-effectiveness is warranted to guide optimal sedation strategies in the ICU.

Keywords: Sedation, Dexmedetomidine, Propofol, Intensive Care Unit (ICU), Post-operative

Introduction

Post-operative care in the Intensive Care Unit (ICU) demands efficient and tailored sedation strategies to optimize patient comfort and recovery while ensuring safety and minimal complications [1]. Sedation, a critical aspect of ICU management, aims to alleviate anxiety, facilitate mechanical ventilation, and promote hemodynamic stability [2]. Dexmedetomidine and propofol represent two commonly utilized agents in this context, each offering distinct pharmacological profiles and advantages in sedation management [3].

Dexmedetomidine, an α2-adrenergic agonist, exerts its sedative effects by selectively targeting the central nervous system, resulting in a state of arousable sedation [4]. Its unique mechanism provides sedation without causing significant respiratory depression, making it an attractive option for critically ill patients requiring prolonged sedation [5]. On the other hand, propofol, a sedative-hypnotic agent, acts rapidly and produces reliable sedation, offering quick onset and recovery owing to its short half-life [6].

Despite their individual merits, comparative studies evaluating the efficacy, safety, and clinical outcomes of dexmedetomidine and propofol in post-operative ICU sedation are limited [7]. Therefore, a comprehensive investigation is warranted to ascertain the relative advantages and potential drawbacks of these agents in a critically ill population.

This study seeks to address this gap by conducting a randomized trial to assess and compare the efficacy of dexmedetomidine and propofol in post-operative ICU sedation. The evaluation will focus on sedation depth, duration, hemodynamic stability, and occurrence of adverse events. The results of this study aim to contribute to the existing literature and guide clinicians in making informed decisions regarding sedation management in post-operative ICU settings.

Materials and Methods

This prospective, randomized controlled trial enrolled 300 post-operative patients admitted to the ICU between January 2022 and December 2022. Inclusion criteria comprised patients aged 18–65 years, undergoing elective surgeries with an expected ICU stay of more than 24 hours. Exclusion criteria involved patients with a history of allergy to study medications, pre-existing neurological conditions, hepatic or renal impairment, or pregnancy.

Upon admission to the ICU, eligible patients were randomly assigned to two groups using a computer-generated randomization sequence: Group A received dexmedetomidine infusion, while Group B received propofol infusion. The study medications were administered according to standardized protocols:

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1. **Dexmedetomidine Group (Group A):** Patients received an initial loading dose of 1 mcg/kg over 10 minutes, followed by a maintenance infusion at a rate of 0.2–0.7 mcg/kg/hr.
2. **Propofol Group (Group B):** Patients received an initial bolus of 1–2 mg/kg, followed by a maintenance infusion at a rate of 2–5 mg/kg/hr.

Sedation depth was assessed using the Richmond Agitation-Sedation Scale (RASS) every hour for the first 24 hours and then every 4 hours subsequently. The target RASS score was maintained between -2 and +1 for adequate sedation depth.

Vital signs including heart rate, blood pressure, respiratory rate, and oxygen saturation were continuously monitored during the study period. Adverse events such as bradycardia, hypotension, respiratory depression, and allergic reactions were documented.

Baseline demographic data including age, sex, BMI, comorbidities, duration of surgery, and Acute Physiology and Chronic Health Evaluation II (APACHE II) scores were recorded for both groups to ensure comparability.

Statistical analysis was performed using SPSS version 25. Continuous variables were expressed as mean ± standard deviation or median with interquartile range based on their distribution. The independent t-test or Mann-Whitney U test was employed for intergroup comparisons, and categorical variables were analyzed using the chi-square test or Fisher's exact test as appropriate. A p-value <0.05 was considered statistically significant.

Ethical approval was obtained from the institutional review board, and written informed consent was acquired from all participants or their legally authorized representatives before inclusion in the study.

Results

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	3.5 ± 1.2	3.4 ± 1.1	0.518

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(hours)			
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

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Discussion

The findings of this study contribute valuable insights into the comparative efficacy of dexmedetomidine and propofol in post-operative ICU sedation, aligning with previous research [1-3]. Both agents maintained adequate sedation depth, as evidenced by comparable RASS scores and the percentage of time within the target sedation range. This aligns with studies suggesting the efficacy of dexmedetomidine and propofol in achieving desired sedation levels [4, 5].

Hemodynamic stability, a crucial aspect in critically ill patients, remained consistent in both groups throughout the study duration [6, 7]. No significant differences in heart rate, blood pressure, or oxygen saturation were noted, corroborating previous studies that reported the cardiovascular safety of both medications [8, 9].

The incidence of adverse events, including bradycardia, hypotension, and respiratory depression, was minimal and comparable between dexmedetomidine and propofol groups. These findings align with existing literature emphasizing the safety profiles of both agents in ICU sedation [10].

However, nuances in their pharmacological profiles warrant consideration. Dexmedetomidine’s unique mechanism of action, providing sedation without significant respiratory depression, may offer an advantage in patients requiring prolonged sedation or those with compromised respiratory function [2]. Conversely, propofol's rapid onset and recovery may be beneficial in procedures requiring short-term sedation or frequent neurological assessments [3].

The study has some limitations. Firstly, the assessment of sedation depth using the RASS scale might not fully capture the individual variability in sedation response. Secondly, the study duration was limited to 72 hours, potentially overlooking long-term effects or differences in sedation quality beyond this timeframe. Moreover, the exclusion of patients with certain comorbidities might limit the generalizability of the findings to a broader ICU population.

Further research with extended follow-up periods and larger sample sizes could provide a more comprehensive understanding of the comparative long-term effects, cost-effectiveness, and patient-centered outcomes associated with dexmedetomidine and propofol in ICU sedation.

Conclusion

In conclusion, this study demonstrates that both dexmedetomidine and propofol are effective and safe choices for post-operative ICU sedation. They maintained comparable sedation depth and hemodynamic stability while exhibiting similar low rates of adverse events. Clinicians can consider either agent based on patient-specific factors, such as duration of sedation required and underlying comorbidities. However, the choice between dexmedetomidine and propofol should be tailored to individual patient needs, considering their distinct pharmacological properties. Further research exploring long-term outcomes and cost-effectiveness is warranted to guide optimal sedation strategies in the ICU.

ISSN: 0975-3583,0976-2833 VOL15, ISSUE 3, 2024

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