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EFFICACY OF DEXMEDETOMIDINE VERSUS PROPOFOL FOR SEDATION IN MECHANICALLY VENTILATED ICU PATIENTS: A HOSPITAL BASED COMPARATIVE STUDY

Dr. Vandana Sharma [1*], Dr. Kritika Joshi [2*], Dr. Nirdesh Kumar[3*]

[1*]Associate Professor, Department of Anaesthesiology and Critical care, VCSGGIMS&R, Srinagar, Uttarakhand, India.
[2]Assistant Professor, Department of Anaesthesiology and Critical care, VCSGGIMS&R, Srinagar, Uttarakhand, India.
[3]Consultant, District Hospital, Rudraprayag, Uttarakhand, India.
***Corresponding Author:** Dr. Vandana Sharma, doct.vandana.sharma@gmail.com

ABSTRACT:
Objective: To compare the sedative efficacy, analgesic profile, and hemodynamic effects of dexmedetomidine and propofol in adult patients receiving mechanical ventilation in the intensive care unit (ICU). **Methods**: A total of 60 ICU patients aged 18–65 years, irrespective of sex, were enrolled and divided into two groups (Group D and Group P), with 30 patients each. Group D received loading dose of dexmedetomidine (1 µg/kg over 10 minutes) followed by an infusion of 0.2–0.7 µg/kg/hour, whereas Group P received loading dose of propofol (0.5–1 mg/kg) followed by an infusion of 25–75 µg/kg/minute.
Heart rate (HR) and blood pressure (BP) were recorded at baseline and at 30 minutes, 1, 2, 6, 12, 18, and 24 hours. Ramsay Sedation Scale (RSS) and Visual Analogue Scale (VAS) scores were assessed at 30 minutes, 1, 2, 6, 8, 12, and 24 hours. **Results**: Mean SBP and mean DBP was significantly lower in group P ($p<0.0001$) as compared to group D. Mean RSS after 1 hour, 2 hours, 6 hours and 24 hours of post sedation was significantly higher in group D, compared to group P ($p<0.05$). mean VAS Score after 2 hour, 2 hours, 6 hours and 24 hours of post sedation were not significant differenced ($p>0.05$). The mean HR dropped consistently in both the groups. Group D experienced more significantly ($p<0.0001$) lower mean HR as compared to group P. **Conclusion**: SBP and DBP are significantly reduced in group P as compared to group D patients. While, HR is significantly reduced in group D patients. Over all, VAS score is greatly reduced in group D as compared to group P patients. Hence, the dexmedetomidine infusion is the safer and more effective sedative agent in the mechanically ventilated ICU patients as compared to propofol infusion.

KEYWORDS: Mechanically ventilated ICU patients, Sedation, Dexmedetomidine, Propofol.

INTRODUCTION

Sedation is an essential component of care for critically ill patients receiving mechanical ventilation. It helps improve patient comfort, facilitate ventilator synchrony, reduce anxiety and agitation, and enable the safe delivery of intensive care interventions [1]. The Society of Critical Care Medicine suggested using either propofol or dexmedetomidine for sedation in mechanically ventilated adults [2].
Mechanical ventilation (MV) is a cornerstone life-support intervention in the intensive care unit (ICU) [3]. By maintaining adequate gas exchange in patients with respiratory failure, severe infection, or multiple organ dysfunction, MV has become a cornerstone of modern critical care and has substantially improved survival [4]. However, its implementation is often complicated by anxiety, agitation, discomfort, and patient-ventilator asynchrony, which can precipitate accidental extubation, hemodynamic instability, and treatment failure [5].
Propofol (PROP), a γ-aminobutyric acid (GABA)-mediated sedative-hypnotic, has been the standard ICU sedative for decades, valued for its rapid onset, predictable titratability, and short context-sensitive half-life [6,8]. However, its use is associated with propofol infusion syndrome at high doses or prolonged infusion, as well as haemodynamic instability and hypertriglyceridaemia [7]. Dexmedetomidine (DEX), a selective α2-adrenergic receptor agonist, has emerged as an important alternative offering a qualitatively distinct form of sedation: it preserves respiratory drive, allows arousable and cooperative sedation, and provides mild analgesia and sympatholysis through a non-GABA mechanism, which may underlie its purported advantage in preventing delirium [9,10].
Despite the availability of several sedative agents, selecting the optimal sedative for mechanically ventilated ICU patients remains challenging.
Several randomized controlled trials (RCTs) have compared dexmedetomidine with propofol for sedation in septic patients in some respects, but drawn different conclusions. Liu et al. [11] concluded that dexmedetomidine could significantly reduce the length of ICU stay among septic patients undergoing mechanical ventilation, while a noninferiority trial comparing dexmedetomidine with propofol in critically ill patients, about half of whom had sepsis, showed that the choice of sedation didn't affect the length of stay in ICU and short-term mortality [9]. A multicenter and double-blind RCT organized by Hughes et al. [12] also declared that there was no significant

difference in short-term mortality, ventilator-free days and ICU length of stay between septic adults who received dexmedetomidine or propofol. The present study was therefore designed to compare the sedative efficacy, analgesic profile, and haemodynamic effects of dexmedetomidine and propofol in mechanically ventilated adult patients admitted to the intensive care unit of a tertiary care hospital.

MATERIALS AND METHODS

The present study was conducted in the Department of Anaesthesiology & Critical Care, VCSGGIMS&R, Srinagar, Uttarakhand, India during a period from May 2026 to December 2026. A total of 60 eligible patients were enrolled and allocated into two groups according to the predefined study protocol. Group D comprised 30 patients who received dexmedetomidine, while Group P comprised 30 patients who received propofol. Each group was followed for 24 hours after initiation of sedation..

Inclusion criteria

1. Adult patients aged 18–65 years.
2. Patients admitted to the intensive care unit requiring invasive mechanical ventilation and requiring continuous intravenous sedation for tolerance of mechanical ventilation.
3. Patients whose legally authorized representatives provided informed consent for study participation.

Exclusion criteria

1. Known hypersensitivity to dexmedetomidine or propofol.
2. Pregnant patients.
3. Patients with acute myocardial infarction.
4. Patients with unstable angina.
5. Patients with any other contraindication to the study medications, as defined in the study protocol.

Group D

Group D Patients were received a loading dose of dexmedetomidine 1 mcg/kg over 10 minutes followed by a maintenance infusion of 0.2-0.7 mcg/kg/hr.

Group P

Group P Patients were received a loading dose of 0.5 to 1 mg/kg followed by an infusion of 25 to 75 mcg/kg/min.

During the period of sedation, patients HR and blood pressure were monitored at baseline and after loading dose administration at intervals of 30 min, 1 hour, 2 hours, 6 hours, 12 hours, 18 hours, 24 hours. The RSS and VAS scores were recorded after sedation at an interval of 30 min, 1 hour, 2 hours, 6 hours, 8 hours, 12 hours and 24 hours.

STATISTICAL ANALYSIS

Data were entered into Microsoft Excel and analysed using IBM SPSS Statistics version 26. Continuous variables were expressed as mean ± standard deviation, while categorical variables were presented as frequencies and percentages. The normality of continuous variables was assessed before selecting appropriate statistical tests. Comparisons between the two groups for continuous variables were performed using the independent-samples t-test or the Mann–Whitney U test, as appropriate. Categorical variables were compared using the Chi-square test or Fisher's exact test, wherever applicable. A two-sided p-value of less than 0.05 was considered statistically significant.

RESULTS

Body Weight and Body Condition Score

The mean age was comparable between Group D (36.4 ± 15.2 years) and Group P (39.3 ± 12.6 years; p=0.4244). Similarly, mean body weight showed no significant difference between Group D (64.15 ± 8.3 kg) and Group P (66.6 ± 6.5 kg; p=0.2081). Of the 60 participants, 34 (56.67%) were male and 26 (43.33%) were female, with comparable sex distribution between the groups (p=0.1456).

Table 1. Comparison of demographic characteristics between the two study groups.

Variables	Group D	Group P	P – value
Male	18(60%)	16(53.33%)	0.1456
Female	12(40%)	14(46.67%)	
Mean age (in years)	36.4±15.2	39.3±12.6	0.4244
Weight (kg)	64.15±8.3	66.6±6.5	0.2081

The baseline values of SBP and DBP were comparable with no significant difference (p=0.4631). Following initiation of sedation, SBP showed variations over the observation period in both groups. The mean SBP values were generally lower in Group P compared with Group D at the subsequent assessment intervals. Between-group differences were statistically significant at all reported post-sedation time points.

Table 2. Comparison of systolic blood pressure (SBP) between the two study groups at different time intervals.

Variables	Group D	Group P	P – value
Before sedation	130.32±10.42	128.52±8.34	0.4631
30 min after sedation	112.3±9.72	102.4±9.21	0.0002
1 hour after sedation	122.7±8.64	111.8±8.75	<0.0001
2 hours after sedation	119.2±7.54	107.7±6.86	<0.0001
6 hours after sedation	112.4±7.42	103.4±7.12	<0.0001
12 hours after sedation	110.6±6.72	101.2±7.21	<0.0001
18 hours after sedation	109.8±5.54	100.8±6.24	<0.0001
24 hours after sedation	110.5±4.64	100.1±5.12	<0.0001

Table 3. Comparison of diastolic blood pressure (DBP) between the two study groups at different time intervals.

Variables	Group D	Group P	P – value	Variables
Before sedation	81.2±8.48	81.2±8.35	1.0000	Before sedation
30 min after sedation	70.5±6.74	69.3±6.54	0.4868	30 min after sedation
1 hour after sedation	72.3±5.62	62.8±5.84	<0.0001	1 hour after sedation
2 hours after sedation	69.2±4.64	61.5±4.76	<0.0001	2 hours after sedation
6 hours after sedation	68.4±5.72	59.3±4.89	<0.0001	6 hours after sedation
12 hours after sedation	66.8±4.24	57.4±4.12	<0.0001	12 hours after sedation
18 hours after sedation	62.5±3.28	59.6±4.12	0.0038	18 hours after sedation
24 hours after sedation	63.6±3.64	59.3±2.52	<0.0001	24 hours after sedation

The mean RSS scores were comparable between the two groups at 30 minutes and 12 hours following initiation of sedation. However, Group D demonstrated significantly higher mean RSS scores at 1, 2, 6, and 24 hours compared with Group P. These findings indicate differences in sedation scores between the two treatment groups during the observation period.

Table 4. Comparison of Ramsay Sedation Scale (RSS) scores between the two study groups.

Variables	Group D	Group P	P – value
30 min after sedation	1.7±0.45	1.6±0.76	0.5376
1 hour after sedation	3.1±0.86	2.0±0.75	<0.0001
2 hours after sedation	3.2±0.65	2.3±0.82	<0.0001
6 hours after sedation	3.4±0.72	2.8±0.56	0.0007
12 hours after sedation	2.8±0.43	2.7±0.52	0.4203
24 hours after sedation	2.5±0.32	2.3±0.26	0.0102

Mean VAS score after sedation after 30 min, 1 hour, 12 hours, 24 hours were comparable between the two groups with significantly higher in group P ($p<0.0001$). Whereas mean VAS Score after 2 hour, 2 hours, 6 hours and 24 hours of post sedation were not significant differenced ($p>0.05$).

Table 5. Comparison of VAS Score among two groups.

Variables	Group D	Group P	P – value
30 min after sedation	1.77±0.65	3.5±.82	<0.0001
1 hour after sedation	1.82±.32	2.34±0.27	<0.0001
2 hours after sedation	2.5±0.54	2.67±0.86	0.3630
6 hours after sedation	2.42±0.74	2.64±0.67	0.2323
12 hours after sedation	2.34±0.54	2.60±0.43	0.0436
24 hours after sedation	2.44±0.52	2.51±0.44	0.5757

Baseline mean HR among two groups was comparable with no significant difference (p=0.4419). Following the initiation of the infusion, the mean HR dropped consistently in both the groups. Group D experienced significantly (p<0.0001) lower mean HR as compared to group P.

Table 6. Comparison of heart rate (HR) between the two study groups at different time intervals.

Variables	Group D	Group P	P – value
Before sedation	98.8±4.23	99.6±3.76	0.4419
30 min after sedation	69.6±9.85	83.8±7.21	<0.0001
1 hour after sedation	86.7±6.54	103.24±3.64	<0.0001
2 hours after sedation	87.5±4.23	102.8±2.12	<0.0001
6 hours after sedation	67.2±5.24	84.5±4.54	<0.0001
12 hours after sedation	64.6±4.61	81.4±2.35	<0.0001
18 hours after sedation	63.43±3.46	81.8±3.12	<0.0001
24 hours after sedation	62.5±2.57	82.0±1.64	<0.0001

DISCUSSION

Sedation is a cornerstone of intensive care for mechanically ventilated patients, facilitating ventilator synchrony, reducing distress, and enabling essential clinical procedures. Achieving an appropriate sedation depth is, however, inherently difficult: under-sedation leads to patient–ventilator dyssynchrony, self extubation, and physiological stress responses, while over-sedation independently prolongs mechanical ventilation (MV), increases ICU length of stay (LOS), and contributes to ICU-acquired delirium, long-term cognitive impairment, and mortality [6,7].

Anger et al highlighted the importance of sedation therapy and pain management as critical factors of improved ICU outcomes and research has spurred the advancement of novel sedatives and sedation protocols tailored for ICU settings. Nevertheless, the quest for the optimal sedative for use in the ICU continues, despite considerable progress in this area [13].

In the present study, we had evaluated dexmedetomidine infusion as a sedative agent in the ICU and compared it to propofol infusion.

The present single-centric investigation revealed that the average age does not exhibit a significant difference between the two groups (0.4244). These results align with the studies conducted by Jakob et al which also reported no statistical significance in age among three groups (p>0.05) [9]. Furthermore, Elgebaly et al similarly observed no age difference between the two groups [14].

In the present study, the sex ratio (male: female) is observed to be 3:2 in the group D (dexmedetomidine group) and 4:3.2 in the group P (propofol group). A study by Rashwan et al [15] involved a total of 90 patients, revealing a sex ratio of 20:10 in the dexmedetomidine group and 19:11 in the propofol group, indicating that the sex distribution aligns closely with the findings of our current study.

In the research carried out by Paliwal et al [16] involving 60 patients, the initial mean arterial pressure (MAP) was found to be similar across both groups. However, a notable decrease in MAP was recorded after the administration of a loading dose of propofol. This observation aligns with the results of our study, which also demonstrated a significant reduction in SBP and DBP following the infusion of propofol (p<0.0001).

In the present study, we observed that the differences in mean HR across various time intervals were statistically significant (p<0.0001) on comparing group D and P. HR decreased more significantly in group D, resulting in a lower mean HR. These findings align with the study conducted by Esmaoglu et al [17] which examined 40 patients with eclampsia on mechanical ventilation, demonstrating that dexmedetomidine leads to a greater reduction in HR compared to midazolam within the first 24 hours. Additionally, similar outcomes were reported by Rashid et al [18] who compared midazolam, propofol, and dexmedetomidine in post-operative eclamptic patients.

Throughout the majority of the time intervals, both group D and P maintained a mean RSS ranging from 2 to 3 and 2 to 2.5 respectively in our study. This outcome aligns with the research conducted by Sharma et al [19] which reported that the RSS was comparable, consistently maintaining a mean score of 2 to 3 across most time intervals in both groups. Shah PN et al [20] indicated that the mean RSS ranged from 2 to 4 for the dexmedetomidine group and from 2 to 3 for the propofol group. We also observed mean RSS was more (2 to 3) in group D (dexmedetomidine group) compared to group P (propofol group) (2 to 2.5).

Mechanically ventilated ICU patients are commonly sedated to facilitate tolerance to artificial airway and other interventions. Dexmedetomidine, a highly selective alfa-2-agonist, was approved in Europe in 2011 for light to moderate ICU sedation. Recent studies suggest that dexmedetomidine may reduce the time to extubation compared with standard sedation [10,9]. However, reductions in MV or length of stay in the ICU do not necessarily always lead to cost savings [21,22,23].

Dexmedetomidine is widely used for ICU sedation due to its favorable pharmacologic profile, its effect on mortality remains controversial. Several randomized controlled trials (RCTs) have examined its impact, yielding inconsistent results. Early studies such as the MENDS trial suggested a potential mortality benefit, particularly in septic patients, where dexmedetomidine was associated with a lower 28-day mortality compared to lorazepam[24]. However, subsequent larger trials, including the MIDEX, PRODEX and SPICE III trials, found no significant differences in ICU or long-term mortality when comparing dexmedetomidine to standard agents like propofol or midazolam [9,25]. Notably, SPICE III revealed age-related heterogeneity: older patients (>65 years) exhibited a trend toward improved survival with dexmedetomidine, whereas younger patients experienced slightly worse outcomes [26]. Meta-analyses have further clarified these discrepancies. While dexmedetomidine appeared to reduce mortality compared to benzodiazepines, no such advantage was observed when compared with propofol [27,28]. Additionally, dexmedetomidine may offer greater benefit in patients with lower illness severity, as reflected in studies showing improved outcomes in lower APACHE IV quartiles [29]. Dexmedetomidine often showed benefit over benzodiazepines but not over propofol, a sedative with an already favorable safety profile [30]. Trials such as SPICE III included broad ICU cohorts, including younger or postoperative patients requiring deep sedation, which dexmedetomidine alone may not adequately provide [25]. This led to frequent crossover and adjunctive sedative use, diluting treatment effects. Moreover, illness severity further modified treatment response. Patients with preserved organ function may benefit more from sympatholytic and anti-inflammatory effects of dexmedetomidine, while sicker patients may see limited or no benefit.

The present study has certain limitations. First, the relatively small sample size and single-centre design may limit the generalizability of the findings. Second, the observation period was restricted to 24 hours, which may not adequately reflect the long-term effects of the study medications. Third, the study did not provide comprehensive information regarding the severity of illness, duration of mechanical ventilation, ICU length of stay, delirium, or mortality. Additionally, the assessment of pain and the influence of concomitant analgesic administration may have affected the interpretation of analgesic outcomes. Further multicentric studies involving larger patient populations and longer follow-up periods are warranted.

CONCLUSIONS

The present study concluded that the SBP and DBP are significantly reduced in group P as compared to group D patients. While, HR is significantly reduced in group D patients. Over all, VAS score is greatly reduced in group D as compared to group P patients. Hence, the dexmedetomidine infusion is the safer and more effective sedative agent in the mechanically ventilated ICU patients as compared to propofol infusion.

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