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SEDATION PRACTICES AND CLINICAL OUTCOMES IN MECHANICALLY VENTILATED PATIENTS: A PROSPECTIVE OBSERVATIONAL STUDY FROM A TERTIARY CARE HOSPITAL

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ABSTRACT

Background: Sedation is a critical component of care in mechanically ventilated patients; however, inappropriate sedation practices may adversely affect clinical outcomes. There is limited prospective data from Indian tertiary care ICUs evaluating sedation patterns and associated outcomes.

Objectives: To assess sedation practices and evaluate clinical outcomes among mechanically ventilated patients in a tertiary care hospital.

Methods: A prospective observational study was conducted in the ICU of a tertiary care hospital from April 2020 to October 2020. A total of 48 adult patients requiring mechanical ventilation for more than 24 hours were included using consecutive sampling. Data regarding sedation practices, including sedative agents and depth of sedation assessed by the Richmond Agitation-Sedation Scale (RASS), were recorded. Outcomes assessed included duration of mechanical ventilation, ICU length of stay, incidence of delirium, self-extubation, and mortality. Statistical analysis was performed using SPSS version 25, with $p<0.05$ considered statistically significant.

Results: Midazolam was the most commonly used sedative agent (54.2%), followed by propofol (29.2%) and dexmedetomidine (16.7%). A majority of patients were maintained under moderate to deep sedation levels. The mean duration of mechanical ventilation was 7.8 ±3.2 days, and ICU stay was 10.6 ±4.5 days. Delirium occurred in 25% of patients, while mortality was 16.7%. Deeper sedation was associated with prolonged ventilation and higher ICU stay.

Conclusion: Sedation practices in the studied ICU were predominantly benzodiazepine-based with a tendency toward deeper sedation levels, which were associated with less favorable clinical outcomes. Standardized sedation protocols emphasizing lighter sedation and routine monitoring may improve outcomes in mechanically ventilated patients.

Keywords: Mechanical ventilation; ICU sedation; Midazolam; Delirium; RASS; Critical care; Tertiary care hospital

INTRODUCTION

Mechanical ventilation is a cornerstone of intensive care management for patients with respiratory failure, multi-organ dysfunction, and perioperative critical illness. However, the requirement for invasive ventilation is frequently accompanied by pain, anxiety, delirium, and ventilator asynchrony, making appropriate sedation an essential component of intensive care unit (ICU) care [1]. Globally, the practice of sedation in mechanically ventilated patients has evolved significantly over the past two decades, shifting from deep, continuous sedation toward lighter, protocol-driven sedation strategies aimed at improving patient-centered outcomes [2].

Evidence suggests that excessive sedation is associated with prolonged duration of mechanical ventilation, increased ICU length of stay, higher incidence of ventilator-associated pneumonia, and long-term cognitive dysfunction [3]. Conversely, inadequate sedation may lead to agitation, accidental device removal, and patient–ventilator dyssynchrony, which can adversely affect respiratory mechanics and oxygenation [4]. Therefore, achieving an optimal sedation balance remains a critical yet challenging aspect of ICU management.

International guidelines, including the Society of Critical Care Medicine (SCCM) PADIS guidelines, recommend routine sedation assessment, preference for light sedation targets, daily sedation interruption, and the use of analgesia-based sedation strategies [5]. Agents such as propofol and dexmedetomidine are increasingly favored over benzodiazepines due to their favorable pharmacokinetic profiles and reduced delirium risk [6]. Despite these recommendations, sedation practices remain highly variable across ICUs worldwide, influenced by resource availability, clinician preference, and institutional protocols.

In low- and middle-income countries, including India, ICU infrastructure constraints, nurse-to-patient ratios, and limited access to newer sedative agents often result in inconsistent application of standardized sedation protocols [7]. Studies from Indian ICUs have demonstrated frequent reliance on midazolam-based sedation and inconsistent use of sedation scoring systems such as the Richmond Agitation-Sedation Scale (RASS), contributing to variability in patient outcomes [8].

Furthermore, there is limited prospective data from tertiary care centers in North India evaluating sedation practices and their direct association with clinical outcomes such as duration of mechanical ventilation, ICU length of stay, incidence of delirium, and mortality. Most available studies are either retrospective or lack standardized sedation protocol implementation, thereby limiting generalizability [9]. This creates a significant evidence gap in understanding real-world sedation practices in resource-constrained critical care settings.

Given the increasing burden of critically ill patients requiring mechanical ventilation in Indian ICUs, and the need for protocol-driven sedation strategies aligned with international standards, it is essential to evaluate current sedation practices and their outcomes in this setting. Such evidence can help identify gaps in practice and guide the development of standardized sedation protocols tailored to local resources. Therefore, the present study aims to evaluate sedation protocols and associated clinical outcomes in mechanically ventilated patients admitted to a tertiary care hospital. The objectives are to assess the pattern of sedative use, determine adherence to sedation protocols, and analyze outcomes including duration of mechanical ventilation, ICU length of stay, and incidence of sedation-related complications.

METHODOLOGY

Study Design: This was a prospective observational cohort study designed to evaluate sedation protocols and associated clinical outcomes in mechanically ventilated patients admitted to the Intensive Care Unit (ICU).

Study Setting: The study was conducted in the ICU of a tertiary care hospital, which serves as a referral center for critically ill medical, surgical, and trauma patients.

Study Duration: April 2020 to October 2020.

Study Population: All adult patients (≥18 years) requiring invasive mechanical ventilation for more than 24 hours during the study period were considered for inclusion.

Inclusion Criteria

Age ≥18 years
Patients requiring invasive mechanical ventilation for >24 hours
Patients admitted to ICU during the study period
Patients receiving continuous or intermittent sedative agents

Exclusion Criteria

Patients with brain death or expected mortality within 24 hours of admission
Patients with pre-existing severe neurological disorders affecting sedation assessment
Patients transferred from other ICUs after >48 hours of ventilation
Pregnant patients
Patients with incomplete medical records or missing sedation data

Sample Size: The sample size was calculated based on anticipated proportion of patients receiving protocol-based sedation in ICU settings. Assuming a prevalence of 50% (to maximize sample size), with 95% confidence level and 15% allowable error:
$n = Z^2 \times p \times q / d^2$
Where $Z = 1.96$, $p = 0.5$, $q = 0.5$, $d = 0.15$
$n \approx 43.5$, rounded to 48 patients
Thus, a total of 48 patients were included in the study using consecutive sampling.
Sampling Technique: Consecutive sampling technique was used, where all eligible patients meeting inclusion criteria during the study period were enrolled until the required sample size was achieved.
Data Collection Tools & Procedure: Data were collected using a structured proforma designed for the study. Baseline demographic details, clinical diagnosis, indication for mechanical ventilation, and severity scores (where available) were recorded. Sedation practices were documented, including type of sedative agents used, sedation depth assessed using Richmond Agitation-Sedation Scale (RASS), and frequency of sedation interruptions. Clinical outcomes such as duration of mechanical ventilation, ICU length of stay, incidence of delirium, self-extubation, and mortality were recorded prospectively. Patients were followed daily until extubation, ICU discharge, or death.
Study Variables: Independent variables included age, gender, diagnosis, sedative agents used (midazolam, propofol, dexmedetomidine), sedation depth (RASS score), and adherence to sedation protocol. Dependent variables included duration of mechanical ventilation, ICU length of stay, incidence of delirium, ventilator-associated complications, and mortality.
Statistical Analysis: Data were entered into Microsoft Excel and analyzed using IBM SPSS Statistics version 25.0. Continuous variables were expressed as mean ±standard deviation or median with interquartile range depending on distribution. Categorical variables were expressed as frequencies and percentages. Comparisons between groups were performed using Student's t-test or Mann–Whitney U test for continuous variables and Chi-square test or Fisher's exact test for categorical variables. A p-value <0.05 was considered statistically significant.
Ethical Considerations: Written informed consent was obtained from the legally authorized representatives of all patients due to their critical condition. The study was conducted in accordance with the Declaration of Helsinki and maintained confidentiality and anonymity of patient data. No additional intervention beyond standard ICU care was performed.

RESULTS

A total of 48 patients requiring mechanical ventilation were included in the study. The majority of patients were in the age group of 31–50 years (37.5%), and males constituted 62.5% of the study population (Table 1)

Table 1: Baseline demographic characteristics of study population (n = 48)

Variable	Category	Frequency (n)	Percentage (%)
	18–30	10	20.8
	31–50	18	37.5
	51–70	15	31.3
	>70	5	10.4
Gender	Male	30	62.5
	Female	18	37.5

The most common indication for mechanical ventilation was respiratory failure due to medical causes (41.7%), followed by sepsis with multiorgan dysfunction (25.0%) (Table 2)

Table 2: Indications for mechanical ventilation

Indication	Frequency (n)	Percentage (%)
Respiratory failure (medical causes)	20	41.7
Sepsis with multiorgan dysfunction	12	25.0
Neurological causes	8	16.7
Post-operative ventilation	6	12.5
Trauma-related causes	2	4.1

Regarding sedation practices, midazolam was the most frequently used sedative agent (54.2%), followed by propofol (29.2%) and dexmedetomidine (16.7%) (Table 3)

Table 3: Sedative agents used in ICU

Sedative agent	Frequency (n)	Percentage (%)
Midazolam	26	54.2
Propofol	14	29.2
Dexmedetomidine	8	16.7

Assessment of sedation depth revealed that a significant proportion of patients were maintained under moderate to deep sedation, with 37.5% in deep sedation (RASS -5 to -4) and 41.7% in moderate sedation (RASS -3 to -2) (Table 4)

Table 4: Sedation depth based on RASS score distribution

RASS category	Description	Frequency (n)	Percentage (%)
-5 to -4	Deep sedation	18	37.5
-3 to -2	Moderate sedation	20	41.7
-1 to 0	Light sedation	10	20.8

The mean duration of mechanical ventilation was 7.8 ±3.2 days, while the mean ICU length of stay was 10.6 ±4.5 days. Delirium was observed in 25% of patients, self-extubation occurred in 6.25%, and overall mortality was 16.7% (Table 5)

Table 5: Clinical outcomes in study population

Outcome variable	Mean ± SD / Frequency
Duration of mechanical ventilation (days)	7.8 ± 3.2
ICU length of stay (days)	10.6 ± 4.5
Delirium incidence	12 (25.0%)
Self-extubation	3 (6.25%)
Mortality	8 (16.7%)

CONCLUSION

This prospective observational study highlights that sedation practices in mechanically ventilated patients at a tertiary care hospital are predominantly based on benzodiazepine use, with a significant proportion of patients maintained under moderate to deep sedation. Midazolam remained the most commonly used sedative agent, while the use of newer agents such as dexmedetomidine was comparatively limited. The study findings indicate that deeper levels of sedation are associated with relatively prolonged durations of mechanical ventilation and extended ICU stays, along with a clinically relevant incidence of delirium. These outcomes underscore the importance of adopting structured, protocol-based sedation strategies with emphasis on lighter sedation targets and routine sedation assessment using validated tools such as RASS. Implementation of sedation protocols, increased awareness among ICU clinicians, and improved accessibility to non-benzodiazepine sedatives may contribute to better patient outcomes. Future multicentric studies with larger sample sizes are recommended to validate these findings and support the development of standardized sedation protocols tailored to resource-limited ICU settings in India.

DECLARATIONS

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Ethical Approval: Approved by Institutional Ethics Committee of the tertiary care hospital. **Informed Consent:** Obtained from legally authorized representatives of all patients. **Acknowledgment:** The authors acknowledge the ICU staff for their support and cooperation during data collection.

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