Pakistan Journal of Intensive Care Medicine
eISSN: 2708-2261; pISSN: 2958-4728
www.pjicm.com
DOI: https://doi.org/10.54112/pjicm.v5i02.105
*Pak. J. Inten. Care Med., volume 5(2), **2025**: 105*
Original Research Article

ASSESSMENT OF THE ASSOCIATION OF PREDICTORS OF MORTALITY IN MECHANICALLY VENTILATED PATIENTS

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(Received, 05th June 2025, Revised 18th June 2025, Accepted 06th July, Published 14th July 2025)

ABSTRACT

Background: *Mechanically ventilated patients constitute a high-risk population in intensive care units (ICUs), where a combination of clinical, physiological, and demographic variables frequently determines mortality. Early identification of these predictors is critical to inform therapeutic strategies and improve survival outcomes.* ***Objective:*** *To determine the association of clinical, physiological, and demographic parameters with mortality among patients receiving invasive mechanical ventilation in a tertiary care ICU in Pakistan.* ***Study Design:*** *Descriptive cross-sectional study.* ***Settings:*** *Chest Intensive Care Unit, Gulab Devi Teaching Hospital, Lahore, Pakistan.* ***Duration of Study:*** *August 2023 to January 2024.* ***Methods:*** *A total of 60 adult patients (aged <70 years) who underwent invasive mechanical ventilation were enrolled through non-probability convenience sampling. Demographic characteristics, comorbidities, clinical diagnosis, and indications for intubation were recorded. Post-intubation parameters—including arterial pH, PaO_2/FiO_2 ratio, and Richmond Agitation-Sedation Scale (RASS) scores—were analyzed. The primary endpoint was in-hospital mortality. Statistical analysis was performed using SPSS version 26, with a significance threshold of $p<0.05$.* ***Results:*** *The in-hospital mortality rate was 75% (n=45), while 25% (n=15) of patients were successfully extubated. No significant correlation was found between mortality and demographic factors such as age (p=0.257), gender (p=0.620), or weight (p=0.389). However, significant predictors of mortality included the underlying reason for intubation (p=0.019), particularly low Glasgow Coma Scale scores and cardiac arrest. Comorbid conditions such as diabetes mellitus (p=0.015) and cardiac disease (p=0.030) were also significantly associated with mortality. Moreover, post-intubation arterial pH (p=0.021), PaO_2/FiO_2 ratio (p=0.021), and RASS scores (p=0.000) demonstrated strong associations with adverse outcomes.* ***Conclusion:*** *The etiology of intubation, pre-existing comorbidities, and early post-intubation physiological parameters significantly influence mortality among mechanically ventilated patients. Proactive recognition and targeted management of these predictors may enhance survival outcomes in critically ill ventilated patients.*

Keywords: Mechanical Ventilation, ICU Mortality, Pao_2/Fio_2 Ratio, RASS Score, Comorbidities, Sedation, Predictors of Death

INTRODUCTION

The management of mechanically ventilated patients remains a critical challenge within intensive care settings, particularly as the predictors of mortality in this demographic continue to be a focal point of research. Recent studies have elucidated various factors influencing outcomes in mechanically ventilated patients, particularly in the context of acute respiratory distress syndrome (ARDS) and associated conditions. A key consideration is the role of mechanical power, which has been identified as a significant factor correlating with adverse outcomes in mechanically ventilated patients, implicating its potential to induce ventilator-induced lung injury (VILI) when not appropriately modulated (1).

Comorbidities further complicate the epidemiological landscape concerning mechanically ventilated patients. Studies have indicated that patients with underlying conditions such as hypertension or cardiac injury tend to exhibit higher mortality rates when subjected to mechanical ventilation (2). The assessment of pre-intubation patient factors, including the oxygenation level reflected by the P/F ratio (PaO2/FiO2), highlights the critical importance of accurate and timely decision-making in the initiation of mechanical ventilation (3).

Additionally, the duration of mechanical ventilation itself presents a substantial risk factor, with prolonged ventilatory support often correlating with increased rates of complications such as ventilator-associated pneumonia and prolonged intensive care unit (ICU) stays (4, 5). Recent findings emphasize that adverse outcomes can escalate significantly with the duration of ventilation, with many patients requiring re-intubation or experiencing sequelae that complicate recovery (5, 6). Moreover, unique populations, such as pediatric patients, have been shown to possess distinct risk profiles, with markers like serum cholinesterase levels emerging as independent predictors of all-cause mortality within this group (7).

Importantly, delirium and its various manifestations, including both hypoactive and hyperactive forms, have been associated with worse outcomes in mechanically ventilated patients, necessitating close monitoring and intervention strategies (8, 9). The implementation of care bundles, such as ventilator care protocols, has demonstrated promise in mitigating some of these adverse outcomes by standardizing treatment and ensuring comprehensive care for critically ill patients on mechanical ventilation (10).

Thus, a multifactorial approach to understanding and addressing the predictors of mortality in mechanically ventilated patients is paramount. Continuous efforts in research, aiming to integrate more personalized and evidence-based treatment modalities, will be essential for improving survival outcomes in this vulnerable population.

METHODOLOGY

This cross-sectional descriptive study was conducted in the Chest Intensive Care Unit (ICU) of Gulab Devi Teaching Hospital, Lahore, over a period of six months from August 2023 to January 2024. The primary aim was to identify predictors of mortality among patients receiving invasive mechanical ventilation. The Institutional Review

Board approved the study protocol, and written informed consent was obtained from either the patients or their legal guardians before enrollment.

A total of 60 patients who fulfilled the inclusion criteria were recruited using a non-probability convenience sampling technique. Adult patients aged below 70 years who were invasively mechanically ventilated were included in the study regardless of gender. Patients who were on non-invasive ventilation or under the age of 18 (pediatric population) were excluded. The sample size was calculated using Cochran's formula with a 95% confidence interval and 5% margin of error, based on an estimated prevalence of 4.1%.

Data were collected using a structured questionnaire designed to capture demographic variables (age, gender, body weight), clinical parameters (primary diagnosis, reason for intubation, comorbidities such as diabetes mellitus, hypertension, and ischemic heart disease), and physiological measurements (post-intubation arterial pH, PaO_2/FiO_2 ratio, and Richmond Agitation Sedation Scale [RASS] score). These variables were selected based on their documented or hypothesized association with patient outcomes in the literature.

All data were extracted from patient medical records and bedside charts by trained respiratory therapists and cross-verified with the ICU monitoring systems. The ventilatory and physiological parameters were recorded within the first 24 hours of mechanical ventilation. The primary outcome of interest was in-hospital mortality during the ICU stay, defined as death following mechanical ventilation without successful extubation.

Data analysis was performed using the Statistical Package for Social Sciences (SPSS) version 26. Descriptive statistics, including means and standard deviations for continuous variables and frequencies and percentages for categorical variables, were calculated. The chi-square test was employed to assess associations between categorical predictors and mortality. A p-value of less than 0.05 was considered statistically significant. The results were presented in the form of tables and charts to highlight associations between clinical variables and mortality outcomes clearly.

RESULTS

A total of 60 adult patients receiving invasive mechanical ventilation in the Chest ICU of Gulab Devi Teaching Hospital were included in this cross-sectional study. The mean age of the patients was 50.17 ± 17.89 years, with the youngest patient being 16 and the oldest 80 years. The cohort comprised 71.7% males (n=43) and 28.3% females (n=17). Overall, mortality was observed in 75% (n=45) of patients, while 25% (n=15) were successfully extubated and survived.

No statistically significant association was found between age (p=0.257), gender (p=0.620), or weight (p=0.389) and mortality. (Table 1).

A significant association was observed between mortality and reason for intubation (p=0.019), especially among patients intubated for low GCS and cardiac arrest. Although the diagnosis trended toward significance (p=0.084), the result was not conclusive. (Table 2)

Comorbid conditions such as diabetes (p=0.015) and heart disease (p=0.030) showed a significant association with mortality. Hypertension showed a weaker, non-significant association (p=0.073). (Table 3)

Acid-base imbalance (low pH), hypoxemia (low PaO_2/FiO_2 ratio), and deep sedation (low RASS) were all significantly associated with higher mortality. The most statistically robust predictor was the RASS score (p=0.000), where patients with scores between -1 and -5 had a 94% mortality rate

Table 1: Demographics and Anthropometric Data

Variable	Categories	Expired (n)	Extubated (n)	Total (n)	p-value
Age Group	18–30 years	11	7	18	0.257
	31–50 years	19	4	23	
	51–70 years	15	4	19	
Gender	Male	33	10	43	0.620
	Female	12	5	17	
Weight	30–44 kg	5	0	5	0.389
	45–59 kg	21	6	27	
	60–74 kg	15	8	23	
	75–90 kg	4	1	5	

Table 2: Clinical Diagnosis and Reason for Intubation

Variable	Categories	Expired (n)	Extubated (n)	Total (n)	p-value
Diagnosis	Tuberculosis (TB)	13	3	16	0.084
	COPD	8	4	12	
	CKD	5	0	5	
	Others	19	8	27	
Intubation Cause	Low GCS	16	4	20	0.019
	Hypoxia	4	7	11	
	Airway compromise	12	3	15	
	Hypotension	9	1	10	
	Cardiac arrest	4	0	4	

Table 3: Comorbidity Profile

Variable	Categories	Expired (n)	Extubated (n)	Total (n)	p-value
Diabetes History	Yes	31	5	36	0.015
	No	14	10	24	
Heart Disease	Yes	20	2	22	0.030
	No	25	13	38	
Hypertension	Yes	27	5	32	0.073
	No	18	10	28	

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Table 4.: Physiological Predictors

Variable	Categories	Expired (n)	Extubated (n)	Total (n)	p-value
Post-intubation pH	7.08–7.18	6	0	6	0.021
	7.19–7.29	21	4	25	
	7.30–7.40	4	6	10	
	7.41–7.50	10	5	15	
	7.51–7.55	4	0	4	
PaO_2/FiO_2 Ratio	60–150 mmHg	32	6	38	0.021
	151–250 mmHg	12	6	18	
	251–350 mmHg	1	3	4	
RASS Score	+4 to +1	12	10	22	0.000
	0	1	3	4	
	-1 to -5	32	2	34	

DISCUSSION

The high rate of mortality observed in mechanically ventilated patients underscores the importance of identifying clinical predictors that can guide treatment decisions and improve patient outcomes. In our study, we found that the overall mortality rate among mechanically ventilated patients was notably high at 75%, with only 25% successfully extubated. These findings are consistent with recent evidence suggesting that mortality in critically ill patients undergoing invasive mechanical ventilation remains a significant challenge, with various factors contributing to adverse outcomes Todi & Ghosh, (11, 12).

One of the significant predictors identified in our cohort was the cause for intubation, where conditions such as low Glasgow Coma Scale (GCS) scores and cardiac arrest were notably associated with higher mortality (p=0.019). This aligns with a study by Huang, which emphasizes the critical nature of the neurological status and cardiovascular events in forecasting outcomes in mechanically ventilated patients (12). The findings indicate that patients requiring intubation for severely decreased consciousness or life-threatening cardiac conditions need particularly close monitoring and potentially more aggressive therapeutic strategies.

Additionally, our analysis revealed a significant association between comorbid conditions, particularly diabetes and heart disease, and increased mortality (p=0.015 and p=0.030, respectively). This finding is corroborated by recent literature, which indicates that chronic conditions, particularly diabetes and cardiovascular diseases, are prevalent among critically ill patients and contribute to worse outcomes post-intubation (13, 14). Comorbid conditions may exacerbate the underlying pathophysiology of respiratory failure and complicate recovery due to impaired physiological reserve.

Furthermore, our study noted that physiological parameters post-intubation, specifically low pH, diminished PaO_2/FiO_2 ratios, and decreased sedation levels (as indicated by RASS scores), were significantly associated with mortality. This observation is in agreement with findings from Zhao et al., which outline a critical relationship between the management of ventilation parameters and clinical outcomes in mechanically ventilated patients (3). The strong association between worsening sedation scores and mortality (p=0.000) raises essential questions about the sedation strategies employed in mechanically ventilated patients and their potential need for reevaluation, as inappropriate sedation could contribute to both complications and delayed weaning from mechanical support.

Importantly, while no significant associations were found for age, gender, or weight with mortality in our study, understanding how these demographic factors interact with clinical conditions remains vital. The lack of significant findings in these variables suggests that more nuanced, multifactorial analyses are needed to understand their implications in a mechanically ventilated population (13).

In conclusion, our findings illustrate the complexity of mortality predictors in mechanically ventilated patients. The identified associations reinforce the critical need for tailored management protocols that address not only the physiological aspects of ventilation but also the patients' comorbidities and the underlying causes of acute respiratory failure. Future studies should aim at implementing improved ventilation practices and individualized care strategies to ultimately enhance outcomes for this vulnerable group of patients.

CONCLUSION

In this study, a high mortality rate of 75% was observed among patients receiving invasive mechanical ventilation, underscoring the critical need for early identification of mortality predictors. Significant associations were found between mortality and variables such as the cause of intubation (particularly low GCS and cardiac arrest), presence of diabetes and heart disease, as well as post-intubation physiological indicators like pH, PaO_2/FiO_2 ratio, and RASS score. These findings highlight the multifactorial nature of adverse outcomes in mechanically ventilated patients and emphasize the need for early risk stratification and individualized clinical management. Future prospective multicenter studies with larger sample sizes are warranted to validate these predictors and guide the development of standardized care protocols aimed at reducing ICU mortality.

DECLARATIONS

Data Availability Statement

All data generated or analysed during the study are included in the manuscript.

Ethics approval and consent to participate

Approved by the department Concerned. (IRBEC-85-24)

Consent for publication

Approved

Funding

Not applicable

CONFLICT OF INTEREST

The authors declare no conflict of interest.

AUTHOR CONTRIBUTION

ASIFA KARAMAT (Fellow)

Conception of Study, Development of Research Methodology Design, Study Design, Review of manuscript, final approval of manuscript. Manuscript drafting.

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Manuscript revisions, critical input.
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