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Characteristics and Outcomes of Critically Ill Medical Patients with Invasive Mechanical Ventilation: A Retrospective Cohort Study

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Abstract

Aim: This study investigated the characteristics and outcomes of critically ill medical patients who received invasive mechanical ventilation (IMV) in the intensive care unit (ICU).

Study Design: This retrospective study was conducted between January 2011 and January 2015 in a nine-bed tertiary medical ICU.

Patients older than 18 years who received IMV for more than 48 hours were included. Univariate and multivariate analyses were performed to compare the patients who died and survived in the ICU and to identify the independent risk factors for mortality.

Results: During the study period, among 715 patients admitted to the ICU, 41% received IMV. A total of 296 patients were included in the study. The median Acute Physiology and Chronic Health Evaluation II (APACHE II) score was 22 [18-27]. The most common reasons for initiating IMV were pneumonia (57.1%) and sepsis (48.6%). Sepsis (50.3%) was the most frequent complication. Among 202 patients who underwent a weaning trial, 153 were extubated, 22 of which involved unplanned extubation. Forty-eight patients required a tracheostomy for weaning. A total of 194 patients (65.5%) died in the ICU, while 102 patients (34.5%) were discharged successfully. Independent risk factors for mortality included new-onset sepsis developed under IMV (odds ratio [OR], 95% confidence interval [CI]: 18.39 [9.00-37.56), p<0.01], intubation due to sepsis (OR, 95% CI: 2.72 [1.43-5.19], p=0.02), and a high APACHE II score (OR, 95% CI: 1.11 [1.05-1.16], p<0.01).

Conclusions: Although IMV is an essential lifesaving therapy for critically ill patients, mortality was relatively high in this population. Sepsis, both as the cause of IMV and as a complication, along with elevated APACHE II scores, were the primary determinants of mortality.

Keywords: Intensive care unit; Sepsis; Invasive mechanical ventilation; Mortality.

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Introduction

Invasive mechanical ventilation (IMV) is the most common life-support therapy used in critically ill patients worldwide. It is applied for a broad spectrum of indications, ranging from planned surgical procedures to severe multiple organ failure.[1]

Although frequently lifesaving, IMV has several undesired physiological and clinical complications. These complications may arise from the endotracheal or tracheostomy tube, positive-pressure ventilation (PPV), or therapies administered during IMV care. Ventilator-associated pneumonia (VAP), barotrauma, volutrauma, and pneumothorax are among the complications that can develop during IMV. Many of these complications, particularly VAP and pneumonia-related sepsis, lead to severe outcomes that may culminate in death. Ventilator-associated pneumonia is associated with a twofold increase in mortality, while sepsis increases mortality by 2.16-fold.[2,3]

Despite advancements in ventilator technology, the introduction of modern ventilation strategies, and the widespread implementation of infection control measures in many intensive care units (ICUs), IMV-associated mortality remains high.[4] Mortality rates range from 28% to 78% across different centers and ICU populations.[5-9] In patients undergoing IMV, achieving optimal outcomes hinges on preventing complications and reducing mortality. Thus, it is essential to identify the epidemiological characteristics of these patients and to determine and mitigate the factors contributing to mortality.

Moreover, much of the data related to the epidemiology and outcomes of mechanically ventilated patients are derived from multicenter cohorts on diverse subjects. These findings are often presented as supplementary results from studies focused on general ICU populations. When considering the patient population of medical ICUs, which often includes individuals with multiple comorbidities and complex medical conditions, it becomes evident that better defining the outcomes of IMV in these patients requires focused attention. Therefore, we conducted this study to determine the characteristics and outcomes of critically ill medical patients who received IMV in the ICU.

Materials and Methods

This retrospective study was conducted between January 2011 and January 2015 in a nine-bed tertiary medical ICU at Gazi University Hospital. The research protocol adhered to the Declaration of Helsinki and was approved by the Gazi University Clinical Research Ethics Committee (Approval Number: 125 Date: 14.12.2015). Due to the retrospective nature of the study, informed consent was not applicable. A total of 296 consecutive medical ICU patients meeting the inclusion criteria and admitted to the nine-bed tertiary medical ICU between January 2011 and January 2015 were included in the analysis. Patients aged older than 18 years who underwent IMV for more than 48 hours in the medical ICU were included. Exclusion criteria were patients younger than 18 years, those who did not require IMV, and terminally ill patients. Terminal illness was defined as a disease that cannot be cured or adequately treated and is expected to result in death, indicating a condition that will progress to death with near absolute certainty, regardless of treatment.[10]

Epidemiological and laboratory data were collected from electronic hospital records and medical archives. The recorded variables included patients' age, gender, data hospitalization data prior to ICU admission, Acute Physiology and Chronic Health Evaluation II (APACHE II) score, Glasgow Coma Scale (GCS) score, Sequential Organ Failure Assessment (SOFA) score upon admission, cause and initiation of IMV, follow-up data regarding IMV support, ICU admission diagnosis, comorbidities, requirement for hemodialysis, primary site of infection, and ICU mortality rates. APACHE II, Risk, Injury, Failure, Loss, and End-stage Renal Disease (RIFLE), and SOFA scores were calculated within 24 hours of ICU admission. For patients with multiple periods of IMV, only the first episode was included. ICU mortality was used as the primary endpoint of the study.

Statistical analysis was performed using IBM SPSS software (version 22.0, IBM Corp., New York, NY). Variables were reported as medians [interquartile ranges] or frequencies (percentages). Patients were divided into two groups based on ICU survival, and data were compared between ICU survivors and non-survivors. The Mann-Whitney U test was used to compare medians of continuous variables, and the chi-squared test was employed to compare categorical variables. Logistic regression analysis was conducted to identify independent risk factors for ICU mortality associated with IMV. A p value of less than 0.05 was considered statistically significant.

Results

Over the study period, 1,051 patients were admitted to the ICU. Of these, 163 patients were hospitalized for less than 48 hours, 105 were in the terminal stage, and 68 had insufficient data. Among the remaining 715 patients, 417 did not require IMV, and two were transferred to another center before weaning. Thus, 296 patients were ultimately included in the study.

General Characteristics of the Study Population

The characteristics of the study population are summarized in Table 1. Of the patients, 54.1% were male, and the median age was 67 years [56-77]. The median APACHE II, GCS, and SOFA scores were 22 [18-27], 10 [7-14], and 7 [5-11], respectively. The most common reasons for ICU admission were acute respiratory failure (67.9%) and sepsis (47.0%). Patients were frequently admitted from medical wards (44.9%), and the median ICU stay was 10 days [6-22] (Table 1).

Table 1. General characteristics of patients

	All Patients (n=296)	Deceased (n=194)	Survived (n=102)	p
Age, Years, Median [IQR]	67 [56-77]	67 [58-78]	64 [53-77]	0.108
Male Gender, n (%)	160 (54.1)	106 (54.6)	54 (52.9)	0.807
APACHE II Score, Median [IQR]	22 [18-27]	25 [20-29]	21 [16-23]	<0.001
GCS, Median [IQR]	10 [7-14]	10 [7-14]	12 [8-15]	0.037
SOFA, Median [IQR]	7 [5-11]	9 [6-12]	6 [4-9]	<0.001
Admission From, n (%)				
Medical Wards	133 (44.9)	96 (49.5)	38 (36.5)	0.037
Emergency Department	123 (41.6)	70 (36.1)	53 (52.0)	0.009
Other ICUs	40 (13.5)	28 (14.4)	13 (11.8)	0.594
Length of Stay Prior to ICU, Days, Median [IQR]	4 [1-13]	5 [2-17]	3 [1-8]	0.003
Admission Diagnosis, n (%)				
Acute Respiratory Failure	201 (67.9)	127 (65.5)	74 (72.5)	0.240
Sepsis	139 (47.0)	112 (57.7)	27 (26.5)	<0.001
Cardiac	39 (13.2)	20 (10.3)	19 (18.6)	0.049
Neurological	28 (9.5)	16 (8.2)	12 (11.8)	0.403
Gastrointestinal Bleeding	16 (5.4)	15 (7.7)	1 (1.0)	0.014
Metabolic	8 (2.7)	3 (1.5)	5 (4.9)	0.129
Hepatobiliary	9 (3.0)	5 (2.6)	4 (3.9)	0.501
Postoperative	6 (2.0)	1 (0.5)	5 (4.9)	0.020
Underlying Diseases, n (%)				
Hypertension	138 (46.8)	90 (46.4)	48 (47.1)	0.944
Cardiac Disease	119 (40.2)	81 (41.8)	38 (37.3)	0.453
Chronic Kidney Disease	103 (34.8)	74 (38.1)	29 (28.4)	0.095
Pulmonary Disease	98 (33.1)	57 (29.4)	41 (40.2)	0.060
Diabetes Mellitus	94 (31.8)	63 (32.5)	31 (30.4)	0.715
Neurological Disease	45 (15.2)	30 (15.5)	15 (14.7)	0.863
Hematological Malignancy	47 (15.9)	37 (19.1)	10 (9.8)	0.038
Rheumatological Disease	25 (8.4)	19 (9.8)	6 (5.9)	0.250
Solid Malignancy	23 (7.8)	15 (7.8)	8 (7.8)	0.983
Cirrhosis	8 (2.7)	6 (3.1)	2 (2.0)	0.568
ICU Length of Stay, Days, Median [IQR]	10 [6-22]	12 [6-24]	9 [6-15]	0.024
ICU Mortality	194 [65.5]	-	-	-

Values are presented as median [interquartile range] or n (%). Abbreviations: ICU: Intensive Care Unit; n: Number; IQR: Interquartile Range; APACHE II: Acute Physiology and Chronic Health Evaluation II; GCS: Glasgow Coma Scale; SOFA: Sequential Organ Failure Assessment.

Characteristics of Invasive Mechanical Ventilation Therapy

The general characteristics of IMV therapy are summarized in Table 2. The most common indications for IMV were pneumonia (57.1%) and sepsis (48.6%). Non-invasive mechanical ventilation (NIMV) was applied in 49.7% of patients, with the majority receiving NIMV prior to IMV initiation (36.5%). Assist control volume control mode was the most frequently used initial ventilation mode (80.7%), with a tidal volume set at 480 [425-500] ml on the first day of ventilation.

The clinical course of patients under IMV is depicted in Figure 1. A total of 296 patients were included in the study. Six patients had pre-existing tracheostomies at ICU admission, and 88 patients died without undergoing a weaning trial. Two hundred two patients proceeded to weaning. Among these, 21 patients died during the process, 28 required tracheostomy, and 153 were extubated. Unplanned extubation (self-extubation) occurred in 22 patients, 16 (73%) of whom were re-intubated. Of the 131 patients (65%) who underwent weaning, 131 were successfully extubated following a planned weaning trial, referred to as planned extubation. Among these patients, 74 (56%) were ventilator-free at discharge, while 57 (44%) required reintubation. Overall, 84 patients (64%) out of 131 who underwent planned extubation and 11 patients (50%) out of 22 who self-extubated were discharged alive (Fig. 1).

Among the 28 patients who required tracheostomy for weaning, 23 (82%) died in the ICU, 3 (11%) were discharged with tracheostomies in place, and only 2 (7%) were ventilator-free at discharge.

Outcome

Of the 296 patients who underwent IMV, 194 (65.5%) died in the ICU, 94 (31.8%) were discharged successfully without any ventilation support, and 8 (2.7%) were discharged with tracheostomies (Fig. 1). The median length of ICU stay was 10 days [6-22], and the median duration of IMV was 8 days [4-17].

The comparison of patients who died and survived in the ICU is presented in Tables 1 and 2. The two groups were similar in terms of demographic characteristics. There were no significant differences between survivors and non-survivors regarding initial ventilation modes, delivered tidal volume, applied positive end-expiratory pressure (PEEP), and measured peak pressure ($p>0.05$ for all results) (Table 2). The independent risk factors for mortality were new-onset sepsis developed under invasive mechanical ventilation [odds ratio [OR], 95% confidence interval [CI]: 18.385 (9.000-37.557), $p<0.01$], intubation due to sepsis [OR, 95% CI: 2.719 (1.425-5.186), $p=0.02$)], and higher APACHE II score [OR, 95% CI: 1.105 (1.051-1.161), $p<0.01$] (Table 3).

Discussion

Invasive mechanical ventilation is the leading organ support therapy in ICUs. In this study, patients admitted to the nine-bed tertiary medical ICU of a university hospital between January 2011 and January 2015 were retrospectively analyzed for IMV therapy. Among patients hospitalized for more than 48 hours who were not terminally ill, 41% required IMV. The median age of these patients was 67 years, and the median APACHE II and GCS scores were 22 and 10, respectively. The primary indication for IMV was pneumonia (57%), followed by sepsis (49%). The outcomes of IMV revealed an ICU mortality rate of 66%, while 34% of patients were discharged, with 3% requiring tracheostomy. The median length of ICU stay was 10 days, the median IMV duration was 8 days, and the median weaning duration was three days. Independent predictors of mortality included sepsis onset during IMV, higher APACHE II scores, and intubation due to sepsis.

While IMV is lifesaving intervention for ICU patients, it is associated with significant risks, including fatal complications such as VAP, barotrauma, and pneumothorax, which contribute to the high mortality rates. The literature reports mortality rates ranging from 28% to 78% among mechanically ventilated patients, depending on patient characteristics and disease severity.[5-8] There is no prior national data on outcomes for medical ICU patients requiring IMV in Turkiye. In this study, we observed a relatively high mortality rate of 66%. We identified higher APACHE II scores, sepsis as the indication for IMV, and sepsis development during IMV as independent predictors of mortality. The high mortality rate in our study can be attributed to several factors. First, the ICU was a medical ICU, differing from mixed medical-surgical ICU settings.[11] Second, our cohort frequently included patients with a high risk of mortality, particularly those requiring IMV for sepsis, which independently predicted mortality in this population. For instance, in Esteban et al.'s study,[8] IMV for sepsis accounted for only 8.8% of cases, with a lower overall mortality rate of 30.7%, while

Table 2. Characteristics of invasive mechanical ventilation therapy

	All Patients (n=296)	Deceased (n=194)	Survived (n=102)	p
IMV Indications, n (%)				
Pneumonia	169 (57.1)	118 (60.8)	51 (50.0)	0.074
Sepsis	144 (48.6)	115 (59.3)	29 (28.4)	<0.001
Acute Exacerbation of COPD or Asthma	51 (17.2)	23 (11.9)	28 (27.5)	0.001
Airway Protection	41 (13.9)	26 (13.4)	15 (14.7)	0.758
Neurological Diseases	31 (10.5)	18 (9.3)	13 (12.7)	0.355
Cardiac Arrest	30 (10.1)	14 (7.2)	16 (15.7)	0.022
ARDS	28 (9.5)	23 (11.9)	5 (4.9)	0.052
Other Causes of Hypoxic Respiratory Failure*	16 (5.4)	9 (4.6)	7 (6.9)	0.421
Pulmonary Edema	15 (5.1)	4 (2.1)	11 (10.8)	0.001
Aspiration	14 (4.7)	7 (3.6)	7 (6.9)	0.210
Post-operative	10 (3.4)	3 (1.5)	7 (6.9)	0.016
NIMV, n (%)	147 (49.7)	93 (47.9)	54 (52.9)	0.413
Before IMV	108 (36.5)	81 (41.8)	27 (26.5)	0.009
After IMV	77 (26.0)	33 (17.0)	44 (43.1)	<0.001
First-Day IMV Parameters				
ABG Analysis, Median [IQR]				
pH (n=184)	7.28 [7.18-7.41]	7.31 [7.20-7.42]	7.21 [7.16-7.33]	0.004
pCO2 (mmHg, n=184)	39 [29-54]	36 [28-46]	47 [31-72]	<0.001
HCO3 (meq/L, n=180)	19 [15-24]	18 [15-22]	21 [17-26]	0.009
pO2/FiO2 (n=93)	180 [108-220]	157 [103-219]	193 [144-233]	0.189
Lactate (mmol/L, n=96)	2.0 [1.2-4.6]	2.8 [1.4-5.4]	1.4 [1.0-3.8]	0.021
Modes and Parameters				
A/C; VC, n (%)	239 (80.7)	158 (81.4)	81 (79.4)	0.674
A/C; PC, n (%)	56 (18.9)	36 (18.6)	20 (19.6)	0.826
PSV, n (%)	1 (0.3)	1 (0.5)	0 (0)	1.000
TV (mL, n=113), Median [IQR]	480 [425-500]	480 [420-500]	480 [440-500]	0.742
PEEP, (cmH2O, n=118), Median [IQR]	5 [5-6]	5 [5-6]	5 [5-5]	0.397
Peak Pressure, (cmH2O, n=101), Median [IQR]	25 [20-30]	25 [20-30]	27 [22-33]	0.094
Analgesic and Sedative Use, n (%)	132 (44.6)	93 (47.9)	39 (38.2)	0.110
Midazolam	92 (31.1)	68 (35.1)	24 (23.5)	0.048
Propofol	52 (17.6)	38 (19.6)	14 (13.7)	0.261
Morphine or Derivatives	33 (11.1)	26 (13.4)	7 (6.9)	0.119
Haloperidol	20 (6.8)	13 (6.7)	7 (6.9)	1.000
Neuromuscular Blockers, n (%)	30 (10.1)	26 (13.4)	4 (3.9)	0.009
Steroid Use, n (%)	200 (67.6)	141 (72.7)	59 (57.8)	0.013
During IMV, n (%)				
Ventilator-Associated Pneumonia	106 (35.8)	96 (49.5)	10 (9.8)	<0.001
Sepsis	149 (50.3)	136 (70.1)	13 (12.7)	<0.001
Acute Kidney Injury Requiring RRT	139 (47.0)	118 (60.8)	21 (20.6)	<0.001
Gastrointestinal Bleeding	30 (10.1)	27 (13.9)	3 (2.9)	0.002
ARDS	16 (5.4)	13 (6.7)	3 (2.9)	0.279
Pneumothorax	6 (2.0)	5 (2.6)	1 (1.0)	0.668
Subcutaneous Emphysema	2 (0.7)	1 (0.3)	1 (1.0)	1.00
Duration of IMV, Days (n=296), Median [IQR]	8 [4-17]	11 [5-22]	5 [3-9]	<0.001
Weaning Time, Days, (n=202), Median [IQR]	3 [1-7]	5 [2-11]	2 [1-4]	<0.001
Planned Extubation, (n=202), Median [IQR]	131 (44.2)	47 (24.2)	84 (82.4)	<0.001
Self-Extubation (n=202), Median [IQR]	22 (7.4)	11 (5.7)	11 (10.8)	0.160
Tracheostomy on Admission, Median [IQR]	6 (2.0)	4 (2.1)	2 (2.0)	0.953
Extubation with Tracheostomy, Median [IQR]	48 (16.2)	40 (20.6)	8 (7.8)	0.005

Values are presented as median [interquartile range] or n (%). IMV: Invasive Mechanical Ventilation; COPD: Chronic Obstructive Pulmonary Disease; ARDS: Acute Respiratory Distress Syndrome; pCO2: Partial Pressure of Carbon Dioxide; HCO3: Bicarbonate; pO2/FiO2: Ratio of Arterial Oxygen Partial Pressure to Fractional Inspired Oxygen; A/C: Assisted Control; VC: Volume Control; PC: Pressure Control; PSV: Pressure Support Ventilation; TV: Tidal Volume; PEEP: Positive End-Expiratory Pressure; NIMV: Noninvasive Mechanical Ventilation; RRT: Renal Replacement Therapy. *Includes pulmonary thromboembolism, alveolar hemorrhage, and vasculitis.

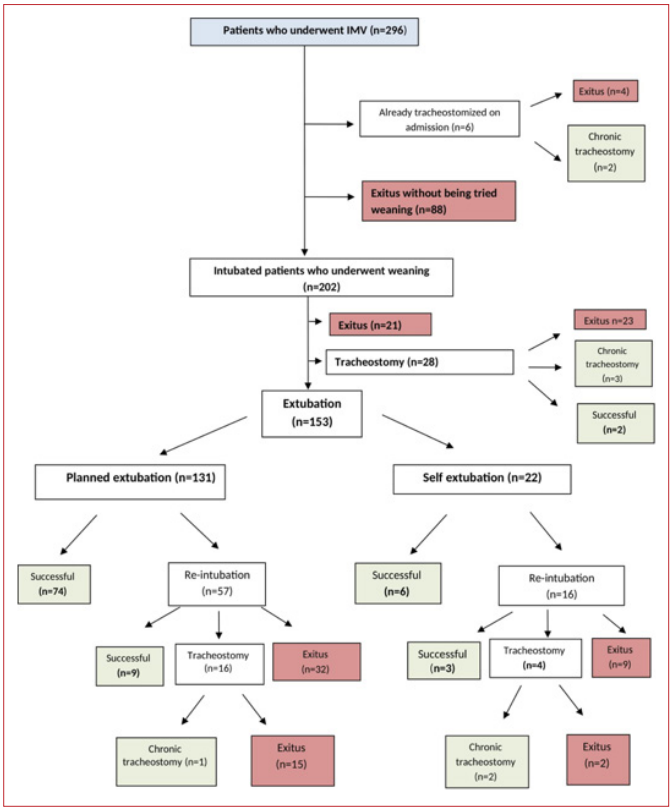

Figure 1. Clinical course of patients under invasive mechanical ventilation.

postoperative patients comprised the largest group at 20.8%. In contrast, in our study, postoperative patients represented only 2%, whereas sepsis was the indication for IMV in 47%, reflecting a more severely ill population. In the same study, while overall mortality was relatively low, mortality reached 52% in the acute respiratory distress syndrome (ARDS) subgroup, with the authors emphasizing that mortality can be significantly higher in more severely ill patient groups, similar to our cohort.[8] Third, the median APACHE II score in our study was 22, reflecting a high disease severity score previously identified as a strong predictor of mortality.[6,11] Furthermore, our study demonstrated that a higher APACHE II score independently increased the risk of ICU mortality by 1.1 times. Multi-center studies with large patient populations and long-term follow-up data are necessary to confirm our findings.

Additionally, we found that new-onset sepsis developed under IMV therapy was the most significant predictor of mortality, increasing the risk by 18.4 times. Unfortunately, this was also the most common complication among our mechanically ventilated patients. Unlike other studies that identify age as a predictor of mortality, our analysis

Table 3. Independent risk factors for intensive care unit (ICU) mortality in patients with invasive mechanical ventilation

Risk Factor	Odds Ratio (95% CI)	p
Sepsis During IMV	18.39 [9.00-37.56]	<0.001
IMV Etiology: Sepsis	2.72 [1.43-5.19]	0.002
APACHE II Score	1.11 [1.05-1.16]	<0.001

IMV: Invasive Mechanical Ventilation; APACHE II: Acute Physiology and Chronic Health Evaluation II.

did not find age to have a significant impact. This may be attributed to the severity of illness in our patient population, which could have overshadowed the influence of age on ICU mortality.[6] Based on our findings, and given the constraints of patient selection, preventing sepsis appears to be crucial for reducing mortality in patients requiring IMV. Further studies are necessary to evaluate the impact of sepsis prevention and treatment strategies on reducing mortality in this population.

Regarding IMV settings, the most commonly used ventilation mode was assist control volume control (A/C VC) at 81%, followed by assist control pressure control (A/C PC). No significant differences were observed between survivors and non-survivors in initial ventilation modes, tidal volume, positive end-expiratory pressure (PEEP), or peak pressure . Despite the technical and physiological differences between A/C VC and A/C PC modes, no outcome differences were observed in our study, consistent with existing data.[12,13] A potential limitation in this regard is that we only analyzed initial IMV parameters; more detailed data might provide further insights. Another possible explanation for this finding may be the mechanical ventilation protocol routinely implemented in our unit. In both our unit and this study, all patients were managed using low tidal volume and lung-protective ventilation strategies. Prospective and comprehensive studies are needed to evaluate the impact of different mechanical ventilation protocols on mortality.

In our study, only 70% (202 patients) of the 290 patients who underwent IMV reached the weaning trial phase. Of the patients who underwent a weaning attempt from mechanical ventilation, 131 (65%) were successfully extubated. However, 44% required reintubation, and only 64% (84 patients) were ultimately discharged. Among these patients, 22 (11%) experienced self-extubation during the weaning process. Of those, 73 were reintubated, and eventually, 50% (11 patients) were discharged. Here, it is evident that although the rate of reintubation after

self-extubation is higher than after planned extubation, the survival outcomes are not significantly worse. This finding may be explained by the significant impact of sepsis episodes occurring after IMV and during the ICU stay on mortality, as demonstrated in our study, rather than by the effects of self-extubation and reintubation. Mortality in extubated patients appears to be influenced more significantly by the development of sepsis during the ICU stay. Prospective multicenter studies with long-term follow-up data on IMV outcomes may be beneficial.

Of the 202 patients who underwent a weaning trial, 28 were weaned through tracheostomy. However, it was observed that only 7% of these patients were discharged ventilator-free, while 82% died. In another study evaluating tracheostomy patients in our ICU, it was observed that tracheostomies were performed on the 16th day of IMV. The mortality rate was also 82%, with surviving patients being younger and having tracheostomies performed at an earlier stage.[14] Therefore, we believe that the appropriate selection of patients for tracheostomy and the correct timing of the procedure are crucial for improving the efficacy of tracheostomy in these patients.

In our study, NIMV was applied to approximately half of the patients either before or after IMV. NIMV was used more frequently before IMV (37%) than after IMV (26%). NIMV and IMV are distinct but complementary respiratory support modalities. It is recommended to switch to IMV in patients who do not respond to NIMV treatment. However, NIMV applied before IMV is not always restricted to this scenario. NIMV can be used, despite the need for IMV, to avoid complications such as VAP. However, many studies have shown that delaying IMV by using NIMV when IMV is indicated increases mortality in numerous patient groups. In a study by Zhang et al.,[15] 657 patients admitted to an emergency ICU were retrospectively analyzed, revealing that early initiation of intubation after NIMV or high-flow nasal oxygen therapy might reduce mortality in critically ill patients meeting IMV criteria. In our study, although the use of NIMV before IMV was not identified as an independent mortality factor in multivariate analysis, univariate analysis showed that NIMV was applied more frequently before IMV in patients who died (42%) compared to those who survived (27%). In another study conducted in our ICU on patients with ARDS and hematological malignancies, mortality was higher in patients who received NIMV before IMV compared to those who received IMV directly. Therefore, we believe that NIMV should not be used in seriously ill patients, and IMV should not be delayed.[16] Further studies with larger patient populations and long-term follow-up data are needed to evaluate the effects of NIMV use.

Our study has several limitations. First, the relatively small number of patients in a heterogeneous ICU population may limit the generalizability of our findings. Second, we only analyzed the initial mechanical ventilation parameters. Detailed data on follow-up IMV parameters during the ICU stay could be crucial for better understanding the impact of IMV on patient outcomes. Third, the retrospective nature of our study may have led to some data loss during the collection process. Finally, we do not have data on the long-term functional status and follow-up outcomes of patients discharged from the ICU.

Conclusion

Invasive mechanical ventilation is one of the most critical life-support treatments frequently used in ICUs. Although IMV is an essential lifesaving therapy for critically ill patients, the mortality rate among medical ICU patients was relatively high. This may be attributed to the relatively high APACHE II scores, high prevalence of comorbidities, and the frequent occurrence of sepsis and multi-organ failure in this patient population.

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