

Risk factors for hospital mortality among mechanically ventilated patients in respiratory ICU

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Background The possible factors affecting hospital mortality among mechanically ventilated patients in respiratory ICU is still not fully studied.

Objective The aim of this study was to identify the predictors of hospital mortality among mechanically ventilated patients in respiratory ICU.

Patients and methods In a prospective descriptive study, all eligible patients of Assiut Chest Department who were mechanically ventilated for more than 1 day (247 patients) during the period from April 2010 to March 2012 were included in this study. Different clinical and laboratory variables were recorded at the time of admission and followed until hospital discharge and were compared between survivors (146 patients) and nonsurvivors (101 patients).

Results A total of 247 patients were included in the study. The mean age was 57.6 ± 13.3 years. Male patients represented 65.6% of the study cohort. The hospital mortality was 40.9%. On multivariate analysis, risk factors for hospital mortality were as follows: patients diagnosed with adult respiratory distress syndrome, interstitial lung diseases, and pulmonary embolism [odds ratio (OR) = 14.2 95% confidence interval (CI), $P = 0.031$]; hospital

complications (OR = 9.17 95% CI, $P = 0.000$); reintubation (OR = 8.56 95% CI, $P = 0.000$); use of sedatives for 24 h or more (OR = 3.72 95% CI, $P = 0.04$); and comorbidity burden (OR = 2.36 95% CI, $P = 0.006$).

Conclusion The major independent risk factor for hospital mortality was patients diagnosed with adult respiratory distress syndrome, interstitial lung diseases, and pulmonary embolism. In addition, patients suffering from more comorbidities or hospital complications and patients requiring longer use of sedation (≥ 24 h) should be monitored closely in ICU because of their high risk for hospital nonsurvival. *Egypt J Broncho* 2015 9:231–237 © 2015 Egyptian Journal of Bronchology.

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Introduction

Mechanical ventilation (MV) is an essential life support for the survival of a significant percentage of patients admitted to the ICUs. Patients admitted in the ICUs in the developing world are substantially different from those in developed countries [1].

Mortality associated with MV has been amply described, with widely varied results. Mortality may be set at around 40%, although it depends on different factors [2]. The aim of the clinical practice is to decrease the mortality rate in ICUs. Determination of the risk factors for mortality may provide useful guidance for intensive care patients. Predicting outcomes is an important issue during the management of critically ill patients [3].

Variables that have been commonly linked to an increased risk for in-hospital mortality in mechanically ventilated patients include age, comorbidities, Simplified Acute Physiology Score (SAPS) III, severe adult respiratory distress syndrome (ARDS), deep sedation, duration of MV, and ICU complications [4–7]. However, there is a wide variation in the prognostic variables between studies, which may be related to

differences in the characteristics of patient cohorts, clinical variables recorded, and the geographical setting of different studies [8].

ICU survivors who receive MV for any duration have a substantially higher mortality rate compared with nonventilated ICU patients [9]. It is important to identify patients who are likely to have poor outcome at the time of admission, so that such patients can be managed aggressively [10].

The aim of the study was to identify predictors of death in critically ill adult patients under MV in respiratory ICU.

Patients and methods

Study design and ethics

The present prospective descriptive study was conducted in the respiratory ICU (RICU), Chest Department, Faculty of Medicine, Assiut University Hospital, during the period from April 2010 to March 2012. The study design was approved by the Scientific Ethics Committee of Faculty of Medicine of Assiut University. Informed consent was obtained from the patient or from a surrogate decision maker.

Patients

Among 595 patients who were admitted to the RICU during this period (and supported by either invasive and/or noninvasive ventilation), only 247 patients were intubated and fulfilled the inclusion criteria. Patients were eligible for enrollment (247 patients) if they were admitted to the respiratory ICU with respiratory disorders and required MV for more than 1 day. Exclusion criteria included the following: patients who received noninvasive ventilation without subsequent intubation; age below 18 years; and patients with postarrest encephalopathy.

Baseline patient data

Full history was taken from the patient or their relatives. Full clinical examination was also carried out on the day of ICU admission. Chest radiography, daily assessment of arterial blood gases, and full laboratory assessment were performed. Illness severity and expected mortality were measured on the day of ICU admission with Acute Physiology and Chronic Health Evaluation (APACHE) II score [11] and the SAPS II [12]. Reasons for ICU admission based on a predefined list of medical diagnoses, such as amount of sputum, endotracheal tube diameter, duration of hospitalization before ICU admission, and use of sedative and its duration, were also recorded.

Procedures

All included patients (247 patients) were intubated using endotracheal tubes (ETTs) of size 7.0–8.0 mm. Ventilation was performed with the Puritan-Bennett 840 ventilator (Nellcor Puritan-Bennett 840 ventilator, USA). Patients were adjusted on synchronized intermittent mandatory ventilation, volume-controlled mode, except patients with severe asthma and ARDS, who were adjusted on pressure-controlled mode as a lung protective strategy. The procedure of weaning from MV was considered as early as possible. Weaning was conducted in 166 patients on the basis of the prevailing criteria of ERS, ATS, ESICM, SCCM, and SRLF [13]. The spontaneous breathing trial was performed with either pressure support ventilation (in 88 patients) or automatic tube compensation (in 78 patients).

Other data

Comorbidities were also evaluated on the day of ICU admission. Patients were identified on the basis of the international classification of diseases (ICD-10). Comorbidities included diabetes mellitus, hypertension, moderate-to-severe renal dysfunction (creatinine >3 mg or renal failure), hepatic dysfunction (viral hepatitis, liver cirrhosis, and hepatic failure), ischemic heart disease, heart failure, anemia (HGB < 10 g/dl, which may be the level that affects weaning process), polycythemia (HCT >56% or HGB = 17 and/

or 15 g/dl in male and female patients, respectively), thrombocytopenia (PLT <100 kU/l), obesity (BMI > 30 kg/m²), and history of drug addiction. Comorbidity burden was measured as a sum of comorbidities [14].

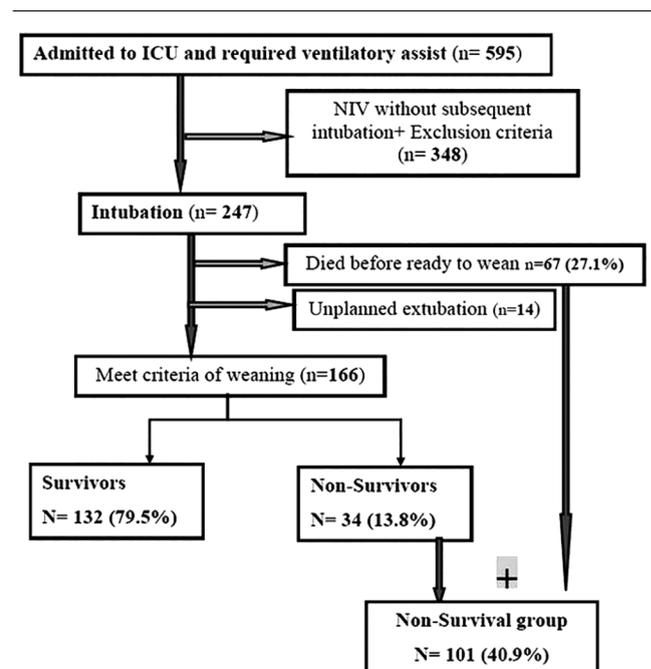
Moreover, prospectively collected data included duration of MV, length of ICU stay, length of hospital stay, reintubation rate, and occurrence of complications arising during the course of the MV and ICU stay (including pneumonia, ARDS, shock, sepsis, barotrauma, major arrhythmia, renal failure, electrolyte disturbance, deep venous thrombosis, and stress ulcer). Hospital mortality was considered as the primary outcome. The course and outcome are summarized in Fig. 1.

Statistical analysis

Data were analyzed using SPSS (Statistical Package for Social Science), version 21 (IBM Inc., Armonk, New York, USA). Data were presented as mean \pm SD for quantitative variables and as frequencies, percentage, median, and range for qualitative variables. *P*-values were determined for both the survival and nonsurvival groups, and a value less than 0.05 was considered significant. Nonparametric tests were used in the current study, such as the Mann-Whitney test (equivalent to independent Student's *t*-test in parametric tests) and χ^2 -test.

Multivariate logistic regression with backward stepwise selection was performed to evaluate risk factors for hospital mortality. Variables with a *P*-value less than 0.05 in the univariate analysis were entered in the multivariable analysis.

Fig. 1



Flowchart of the study.

Results

During the study period, 247 patients were intubated and fulfilled the inclusion criteria. Distribution of patients based on the clinical diagnosis is shown in Table 1. The study included 52 patients with acute respiratory failure and 195 patients with chronic respiratory failure. Hospital mortality was 40.9% (101 patients).

Table 1 Distribution of patients based on clinical diagnosis

Patient diagnosis	Number of patients
Group I (ARF)	52 (21.1)
Asthma	17 (6.9)
ARDS	23 (9.3)
Pulmonary embolism	12 (4.9)
Group II (CRF)	195 (78.9)
COPD	148 (59.9)
CRF non-COPD	47 (19)
Post-TB sequelae	15 (6)
ILDs	14 (5.7)
OHS	13 (5.3)
Kyphoscoliosis	2 (0.8)
Alveolar microlithiasis	2 (0.8)
PPH	1 (0.4)
Total	247 (100)

Data are expressed as *n* (%). ARDS, adult respiratory distress syndrome; ARF, acute respiratory failure; COPD, chronic obstructive pulmonary disease; CRF, chronic respiratory failure; ILD, interstitial lung disease; OHS, obesity hypoventilation syndrome; PPH, primary pulmonary hypertension.

Demographic data and patient characteristics of both groups are shown in Table 2. The number of male patients was 162 (65.6%), whereas the number of female patients was 85 (34.4%). Male patients were significantly predominant among survivors (73.3%) versus nonsurvivors (54.5%), whereas the proportion of female survivors and nonsurvivors was 26.7 and 45.5%, respectively. The mean age was 57.6 ± 13.3 years. The mean age of patients who survived was 56.5 ± 12.7 years, which was nonsignificantly lower compared with patients who died (58.9 ± 14.2 years). The mean BMI was about 26 in total and both groups. There was no significant difference between the two groups as regards BMI, smoking index, the Glasgow Coma scale, and amount of endotracheal secretion. Patients with oliguria at first day of ICU were significantly increased among nonsurvivors.

The importance of early ICU admission was also evaluated. Critically ill patients admitted to the emergency room or hospitalized in the ward for 24 h or more before ICU admission were significantly increased in the nonsurvivor group.

The mean APACHE II score in all patients was 23.75 ± 5.32 , with a mean expected mortality of about 45%. Nonsurvivors had significantly higher APACHE II. The mean SAPS II score in all patients

Table 2 Demographic data and patient characteristics of the studied groups

Parameters	Total (<i>n</i> = 247)	Survival group (A) (<i>n</i> = 146) (59%)	Nonsurvival group (B) (<i>n</i> = 101) (41%)	<i>P</i> -value
Sex				
Male	162 (65.6)	107 (73.3)	55 (54.5)	0.002*
Female	85 (34.4)	39 (26.7)	46 (45.5)	
Age (years)				
Mean \pm SD	57.63 ± 13.32	56.52 ± 12.72	58.94 ± 14.2	0.36
Median (range)	60 (20–86)			
BMI (kg/m ²)	26.59 ± 4.57	26.74 ± 4.42	26.39 ± 4.81	0.55
Smoking index (pack/year)	31.99 ± 12.6	31.6 ± 12.03	32.6 ± 13.01	0.66
Hospitalization before ICU admission (h)				
<24	119 (48.2)	96 (65.8)	23 (22.8)	0.000*
\geq 24	128 (51.8)	50 (34.2)	78 (77.2)	
GCS before intubation	10.02 ± 3.51	10.54 ± 3.04	9.43 ± 4.06	0.071
At ICU admission				
Urine output <500 ml	20 (8.1)	3 (2.1)	17 (16.8)	0.000*
Abundant secretion	137 (55.5)	76 (52.1)	61 (60.4)	0.2
APACHE II	23.75 ± 5.32	22 ± 4.78	26.29 ± 5.04	0.000*
Expected mortality %	45.3 ± 16.47	39.86 ± 14.94	53.13 ± 15.43	0.000*
SAPS II	43.18 ± 12.06	37.71 ± 8.91	51.09 ± 11.56	0.000*
Expected mortality %	34.19 ± 22.02	23.94 ± 15.17	49.02 ± 21.99	0.000*
First tracheal aspirate culture				
Sterile	81 (32.8)	55 (37.6)	26 (25.7)	0.05*
Isolation of pathogens	166 (67.2)	93 (62.4)	73 (74.3)	
Comorbidity burden	2.35 ± 1.39	2.09 ± 1.39	2.74 ± 1.38	0.000*
Use of sedative >1 day	132 (53.4)	50 (34.2)	82 (81.2)	0.000*

Data are presented as mean \pm SD, median (range), or *n* (%). APACHE II, Acute Physiology and Chronic Health Evaluation; GCS, Glasgow Coma scale; SAPS II, Simplified Acute Physiology Score. *P*-value is evaluated for both the survival and nonsurvival groups. *Significant difference.

was 43.18 ± 12.06 , with a mean expected mortality of about 34%. Nonsurvivors had significantly higher SAPS II score compared with survivors. Certainly, expected mortality calculated by both scores was significantly higher in the nonsurvival group.

Sterile cultures obtained from tracheal aspirate cultures taken on admission were significantly associated with the survival group. However, isolation of pathogenic organisms were significantly associated with hospital mortality.

Moreover, the impact of comorbidities and sedation duration on outcome was evaluated. The comorbidity burden (number of comorbidities) and the use of sedative for more than 24 h were significantly increased among patients who died compared with those who survived.

Table 3 shows standardized mortality ratio (SMR), which is defined as the ratio between the actual and predicted hospital mortality. SMR with

Table 3 SMR based on APACHE II and SAPS II

Parameters	Actual hospital mortality [n (%)]	Expected mortality (%)	Standardized mortality ratio (%)
APACHE II	101 (40.9)	45.3	90.3
SAPS II		34.19	119.6

APACHE II, Acute Physiology and Chronic Health Evaluation; SAPS, Simplified Acute Physiology Score; SMR, standardized mortality ratio.

Table 4 Length of stay, duration of MV, and outcome

Parameters	Total (n = 247)	Survival group (A) (n = 146) (59%)	Nonsurvival group (B) (n = 101) (41%)	P-value (A vs. B)
Hospital stay (days)	11.37 ± 8.28	13.01 ± 7.27	8.99 ± 8.06	0.000*
ICU stay (days)	7.03 ± 6.62	6.92 ± 5.091	7.19 ± 6.38	0.78
Duration of MV (days)	3.86 ± 2.75	3.51 ± 2.19	4.35 ± 3.37	0.05*
Reintubation rate [n (%)]	34 (13.8)	9 (6.2)	25 (24.8)	0.000*
Tracheostomy rate [n (%)]	11 (4.5)	2 (1.4)	9 (8.9)	0.006*

MV, mechanical ventilation; *Significant difference.

Table 5 ICU and hospital complications among 247 patients

Complications	Total (n = 247)	Survival group (A) (n = 146) (59%)	Nonsurvival group (B) (n = 101) (41%)	P-value (A vs. B)
Barotrauma	6 (2.4)	1 (0.7)	5 (5)	0.043*
HAP	44 (17.8)	6 (4.1)	38 (37.6)	0.000*
ARDS	28 (11.3)	2 (1.4)	26 (25.7)	0.000*
Shock	93 (37.7)	4 (2.7)	89 (88.1)	0.000*
Sepsis	65 (26.3)	3 (2.1)	62 (61.4)	0.000*
AF or V. arrhythmia	66 (26.7)	17 (11.6)	49 (48.5)	0.000*
Renal failure	46 (18.6)	2 (1.4)	44 (43.6)	0.000*
Hepatic failure	5 (2)	2 (1.4)	3 (3)	0.33
Electrolyte disturbance	148 (59.9)	79 (54.1)	69 (68.3)	0.017*
Others	60 (24.3)	28 (19.2)	32 (31.7)	0.023*
Number of complications	2.27 ± 2.01	0.98 ± 0.97	4.12 ± 1.4	0.000*

Others include deep venous thrombosis (DVT), bed sores, hematemesis, hemoptysis and psychological disturbance. AF, atrial fibrillation; ARDS, adult respiratory distress syndrome; HAP, hospital-acquired pneumonia; V. arrhythmia, ventricular arrhythmia; *Significant difference.

APACHE II (90.3%) showed a lower number of death than is expected (APACHE II overestimated the mortality to a lower extent). However, SMR with SAPS II (119.6%) showed a higher number of death than is expected (SAPS II underestimated the mortality to a higher extent).

In Table 4, the mean duration of hospital stay in all patients was 11.37 ± 8.28 days, whereas for ICU stay it was 7.03 ± 6.62 days. The mean duration of MV was 3.86 ± 2.75 days. Moreover, 34 (13.8%) patients required reintubation and 11 (4.5%) patients required tracheostomy. The differences were statistically significant between the two groups as regards duration of MV, hospital length of stay, reintubation, and tracheostomy rate.

Results for ICU and hospital complications are presented in Table 5. There was statistically significant difference between the two groups as regards the percentage of patients who suffered from barotraumas, hospital acquired pneumonia, ARDS, shock, sepsis, arrhythmia, renal failure, and electrolyte disturbance. The total number of complications was significantly increased in the nonsurvivor group.

The variables related to hospital mortality are shown in Table 5, taking hospital survival as a reference. Multivariate logistic regression identified patients diagnosed with ARDS, interstitial lung diseases (ILDs),

and pulmonary embolism as a major independent risk factor for hospital mortality [odds ratio (OR) = 14.2]. To a lesser extent, patients who suffered from more ICU and hospital complications and reintubation were more likely to not survive (OR = 9.2 and 8.6, respectively). Moreover, patients who required sedation for more than 24 h had a significant trend to hospital mortality (OR = 3.7). Finally, patients with higher comorbidity burden were more likely to not survive (OR = 2.4). However, other variables cannot be considered as independent risk factors for hospital mortality (Table 6).

Discussion

The present study included 148 patients diagnosed with chronic obstructive pulmonary disease (COPD) (59.9%); 47 patients suffered from chronic respiratory failure other than COPD (20.1%) and 52 patients from acute respiratory failure (19%). Sellares *et al.* reported that COPD patients represented 51.9% and chronic respiratory diseases represented 20.4% in a study conducted in the respiratory ICU [15].

As regards demographic data of studied patients, the mean age was ~57.6 years (survivors 56.5 vs. nonsurvivors 58.9 years), with male patients representing ~66%. These results were compatible with those reported by Tonnelier *et al.* [16] and Mansoura *et al.* [17]. Nonsurvivors characterized by nonsignificant older age than those who survived (58.9 years vs. 56.5 years, respectively). The same finding was also reported by Ucgun *et al.* [4]. Female patients were

significantly increased in the nonsurvival than in the survival group (45.5 vs. 26.7%). There was an apparent discrepancy with a study by Cheng *et al.* [18], who reported significant increase in age and nonsignificant increase in female patients in the nonsurvival group. This can be explained by the relatively younger age and female predominance in patients diagnosed with ARDS, ILDs, and pulmonary embolism who had the highest mortality in our study.

No significant difference existed between the survival and nonsurvival groups in terms of BMI and smoking index. The same finding was also reported by Bakr *et al.* [19]. In addition, Macedo *et al.* [20] documented that 10% of ICU patients had oliguria for 24 h. They concluded that oliguria is an early predictor of higher mortality in critically ill patients.

In the present work, 55% of mechanically ventilated patients had abundant tracheal secretion on the first day of ICU admission (depending upon the frequency and amount of tracheal suction) without significant difference between the two groups. Khamiees *et al.* [21] observed that 48% of patients had abundant secretion and 49% had frequent suction (every less than 2 h).

We also found that 51.8% of patients were hospitalized for more than 24 h before being transferred to ICU. The usual cause for the delay in ICU admission was the lack of ICU bed availability. A significant increase in patients hospitalized for more than 24 h was observed in the nonsurvival group. Bing-Hua [22] found that 31.2% of patients were immediately admitted, whereas 68.8% of patients had delayed ICU admission. He concluded that prolonged waiting hours in the ICU because of bed shortage was associated with higher ICU mortality among critically ill surgical patients. Cardoso *et al.* [23] reported the same results in ICU patients.

As regards ICU scores, we found that the average APACHE II score was 23.8 ± 5.3 , with a significant difference between the two groups (survivors 22 ± 5 vs. nonsurvivors 26 ± 5). Likewise, we found that the average SAPS II score was 43.2 ± 12.1 , with a significant difference between the two groups (survivors 38 ± 9 vs. nonsurvivors 51 ± 12). Cohen *et al.* [24] reported similar results (mean APACHE II 22 ± 8). Anzueto *et al.* [25] found a mean SAPS II of 43 ± 18 , which is compatible with our results. Mohan *et al.* [5] and Timmers *et al.* [26] posted that APACHE II and SAPS II were significantly associated with hospital mortality, which is consistent with our results. In contrast, Madkour and Adly [27] reported no significant difference as regards SAPS II between survivors and nonsurvivors.

Table 6 Variables associated with hospital mortality in multiple logistic regression

Parameters	P-value	OR	95.0% CI	
			Lower	Upper
Sex	0.764	1.009	0.952	1.069
BMI	0.093	0.883	0.764	1.021
Hospitalization \geq 24 h before ICU admission	0.630	1.411	0.347	5.745
ARDS/ILD/PE	0.031*	14.185	1.272	158.216
Abundant secretion	0.297	0.478	0.119	1.916
Urine output <500 ml	0.111	0.079	0.003	1.797
Isolation of pathogenic organism	0.093	0.883	0.764	1.021
APACHE II	0.216	1.156	0.919	1.454
SAPS II	0.299	0.945	0.851	1.051
Comorbidity burden	0.006*	2.364	1.281	4.363
Use of sedative >24 h	0.040*	3.720	0.816	16.956
Duration of MV	0.959	1.012	0.648	1.580
Reintubation	0.000*	8.556	2.749	19.743
Number of complications	0.000*	9.167	4.170	20.152

APACHE, Acute Physiology and Chronic Health Evaluation; ARDS, adult respiratory distress syndrome; CI, confidence interval; ILD, interstitial lung disease; MV, mechanical ventilation; OR, odds ratio; SAPS, Simplified Acute Physiology Score; *Significant difference.

In our study, the expected mortality with APACHE II was 45.3 versus 34.2% with SAPS II. This means that APACHE II score overestimated mortality, whereas SAPS II underestimated mortality. The ratio between the actual and predicted hospital mortality was 90.3% for APACHE II and 119.6% for SAPS II. Therefore, we documented that APACHE II was better than SAPS II in estimating hospital mortality. Del Bufalo *et al.* [28] concluded that the APACHE II score was a good predictor of hospital outcome and better than SAPS II, with the ratio between the actual and predicted hospital mortality being 86% for APACHE II and 83% for SAPS II. However, the APACHE II score is neither very sensitive nor specific in terms of mortality prediction. The major limitation of this scoring system is that many patients have several comorbid conditions, and selecting only one principal diagnostic category may be very difficult. In addition, the physiological variables are all dynamic and can be influenced by multiple factors. All these factors can lead to a risk of overestimation of predicted mortality [29].

The first tracheal aspirate cultures were sterile in 32.8%. Khalil *et al.* [30] reported that up to 61.5% of admission cultures were sterile. A significant increase in sterile cultures in the survival group was observed; however, isolation of pathogenic organisms was significantly increased in the nonsurvival group. Mohan *et al.* [5] reported similar finding. The elevated percentage of sterile cultures may be related to the use of conventional culture, which did not discover viral or atypical organisms, and the use of the first tracheal culture only.

Comorbidity burden was 2.1 ± 1.4 among nonsurvivors versus 2.7 ± 1.4 among survivors, with significant difference between the two groups. Ucgun *et al.* [4] posted that the presence of comorbidities was significantly increased in the nonsurvival group. Mukhopadhyay *et al.* [31] reported that 37% of patients had more than three comorbidities and were associated with hospital mortality. Moreover, Cheng *et al.* [32] demonstrated that comorbidity burden significantly increased among nonsurvivors.

We found a significant increase in the use of sedative drugs for more than 24 h in the nonsurvival group. Shehabi *et al.* [33] documented that longer and deep sedation was significantly associated with hospital mortality.

Kahn *et al.* [34] reported that a mean duration of MV of 3.1 ± 4.6 days, mean ICU length of stay of 6.6 ± 6.9 days, and mean hospital length of stay of 12.5 ± 12.2 days. Approximately 15% of patients in whom MV is discontinued require reintubation within 48 h [35]. These results are consistent with our results.

We found a significant increase in the duration of MV, reintubation rate, and tracheostomy rate among patients who died compared with patients who survived. Cheng *et al.* [18] reported that the duration of MV and reintubation significantly increased among nonsurvivors. Moreover, Khalil *et al.* [36] reported that the duration of MV and tracheostomy rate significantly increased in the nonsurvival group. These results are compatible with our results.

In our study, no significant difference was observed in ICU length of stay. However, hospital length of stay was significantly increased in the survival group. Tanaka *et al.* [7] reported similar results. Moreover, several ICU and hospital-related complications were encountered and associated with morbidity and mortality. They included barotraumas, hospital-acquired pneumonia, shock, ARS, sepsis, arrhythmia, electrolyte disturbance, and renal and hepatic failure. We also found a significant increase in complications among nonsurvivors. Ucgun *et al.* [4] and Khalil *et al.* [36] reported similar results.

For in-hospital mortality, multivariate logistic regression was performed to evaluate predictors of hospital mortality. We identified patients diagnosed with ARDS, ILDs, and pulmonary embolism as a major risk factor for hospital mortality (OR = 14.2, $P = 0.031$). We also found that ICU and hospital complications, reintubation, and comorbidity burden were significantly associated with nonsurvival. Moreover, we found that patients who required longer sedation (>24 h) were at increased risk of ICU and hospital death.

Several studies evaluated risk factors for hospital mortality among critically ill patients. Ucgun *et al.* [4] reported that ICU complications and comorbidities could be considered as factors affecting mortality in COPD patients. Mohan *et al.* [5] reported that duration of MV was significantly associated with hospital mortality. Feng *et al.* [6] concluded that age and duration of MV were strongly associated with mortality in critically ill patients. Mansoura *et al.* [17] stated that APACHE II and SAPS II were not associated with hospital mortality in logistic regression analysis and that only the SOFA score was an independent predictor of mortality among the respiratory ICU patients. Bing-Hua [22] documented that significant association between early ICU admission and survival rates existed. Cheng *et al.* [32] reported that the number of comorbidities could be considered as a risk factor for death. Tanaka *et al.* [7] identified age, Charlson comorbidity index >2, SAPS III, severe ARDS, and the deep sedation as major factors associated with hospital mortality in mechanically ventilated patients.

Conclusion

In a respiratory ICU population, ARDS, ILD, and pulmonary embolism patients were at a higher risk for hospital mortality. The present results identified that ICU and hospital complications, reintubation, comorbidity burden, and longer sedation (>24 h) as risk factors associated with hospital mortality among mechanically ventilated patients.

Acknowledgements

Conflicts of interest

None declared.

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