TITLE: Implementation of strategies to liberate patients from mechanical ventilation in a tertiary-level medical center

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ABSTRACT

Background. Considerable discrepancies have been observed in the implementation of strategies to liberate patients from mechanical ventilation. The aim of this study was to describe critical care nurses' knowledge of and self-reported and documented adherence to lung-protective ventilation, daily sedation interruption, and daily assessment of readiness to extubate and evaluate how these practices differ between patients with and without ventilator-associated pneumonia and between survivors and nonsurvivors.

Methods. The survey was conducted in a tertiary-level hospital in Finland from October 2014 to June 2015. Actual adherence was evaluated based on documentation of performed practices.

Results. A total of 86 critical care nurses responded to the survey, and 85 patients were followed. The levels of knowledge of and self-reported adherence to low tidal ventilation were 84.5% and 90.2%, respectively, and the median tidal volume was at a target level in 74.4% of patients. Regarding daily sedation interruption, the level of knowledge was 85.7% and the level of self-reported adherence was 77.3% while documented adherence was 33.3%. The levels of knowledge and self-reported adherence regarding spontaneous breathing trial were 61.9% and 71.6%, respectively. Adherence to lung-protective ventilation, daily sedation interruption, and daily assessment of readiness to extubate did not differ between patients with (*n*=20) and without *(n*=65) ventilator-associated pneumonia and between survivors (*n*=55) and nonsurvivors (*n*=30).

Conclusions. Lung-protective ventilation, including low-tidal ventilation and avoidance of high inspiratory plateau pressures, was well implemented and adhered to. The levels of knowledge and self-reported adherence versus documented adherence regarding daily sedation interruption and spontaneous breathing trial demonstrated insufficient implementation of local guidelines. There was no affect on the outcome.

Keywords: ventilator-associated pneumonia, weaning, sedation, pain management, evidence-based practice

BACKGROUND

Due to the complications associated with mechanical ventilation (eg, ventilator-induced lung injury [VILI], ventilator-associated pneumonia [VAP]), clinicians should implement strategies to liberate patients from mechanical ventilation as soon as the underlying cause has sufficiently improved and the patient is able to maintain spontaneous breathing unassisted. Lung-protective ventilation (eg, the use of more physiological tidal volumes and avoidance of high inspiratory plateau pressures) has been shown to decrease VILI by reducing the duration of mechanical ventilation and improve outcomes in patients with acute respiratory distress syndrome.[1] In addition, the use of noninvasive ventilation (NIV) in selected populations immediately after extubation, protocols minimizing sedation (eg, daily sedation interruption), daily assessment of readiness to extubate (eg, performance of spontaneous breathing trial [SBT] with sedatives turned off, weaning protocols), and facilitation of early mobilization have been shown to speed extubation and reduce the average duration of mechanical ventilation.[2-3]

However, considerable discrepancies have been observed in the implementation of strategies to liberate patients from mechanical ventilation. For instance, adherence to lung-protective ventilation has been low: patients have received a significantly greater median tidal volume compared to their target tidal volume.[4-6] Correspondingly, less than half of respondents have reported using weaning protocols.[7] In addition, significant variation in SBT performance and documentation has been observed worldwide.[8] In line with the findings concerning the use of weaning protocols, only 31% to 44% of respondents have reported using sedation protocols [9-10] while adherence to pain management protocol has been hard to achieve and unacceptably high pain scores have been observed.[11]

Late-onset hospital-acquired pneumonia[12] has been related to high peak inspiratory airway pressure (Ppeak), positive end-expiratory pressure (PEEP), and fraction of inspired oxygen. However, little is known about the relationship of these factors with intensive care unit (ICU)-acquired pneumonia and mortality. Therefore, our study sought to (1) describe critical care nurses' knowledge of and self-reported and documented adherence to lung-protective ventilation, daily sedation interruption, and daily assessment of readiness to extubate, and (2) evaluate how these practices differ between patients with and without VAP and between survivors and nonsurvivors.

MATERIAL AND METHODS

This survey was conducted in a 900-bed tertiary-level university teaching hospital in Finland, from October 2014 to June 2015. The hospital has an adult, closed, mixed medical-surgical ICU with 26 beds. Patients were attended by intensivists that were present in the ICU for 24 hours per day, 7 days a week. As recommended, standard procedures applied throughout the study period included daily sedative interruption, daily assessment of readiness to extubate, semirecumbent positioning, daily oral care with chlorhexidine, strict hand hygiene, and prophylactics for peptic ulcer disease and deep venous thrombosis.

Study population

All registered nurses who were direct care providers were included in the study. In addition, all consecutive adult patients admitted to the ICU who received mechanical ventilation (≥48 h) between October 2014 and June 2015 were enrolled. Patients were excluded if they met any of the following exclusion criteria: pneumonia diagnosis or the presence of tracheostomy, human immunodeficiency virus or significant immune suppression (prolonged neutropenia [>1 week] or chronic steroid therapy with ≥ 40 mg prednisolone daily for >4 weeks) at the time of ICU admission.

Data collection and outcomes

A part of Ventilator Bundle Questionnaire (VBQ) was used to evaluate ICU nurses' sedation and weaning practices.[13] Every close-ended question contained four response alternatives. One point was given if the respondent knew or adhered to the item.

Ventilator-associated pneumonia was defined according to CDC criteria.[14] Chest radiographs were acquired on day 0 (the day of a diagnosis of VAP), on two days prior to the occurrence of VAP, and up to two days post day 0. These radiographs were re-evaluated afterwards by a multidisciplinary team that included a chest radiologist, two intensivists, and an infectious disease physician. Only the first episode of VAP was considered.

Clinical characteristics (eg, age; gender; Acute Physiology and Chronic Health Evaluation [APACHE], new Simplified Acute Physiology Score [SAPS II] and Sequential Organ Failure Assessment [SOFA] scores at admission; Richmond Agitation-Sedation Scale [RASS] and Critical-Care Pain Observation Tool [CPOT] scores, Verbal Rating Scale [VRS] results), respiratory support, ventilator days, as well as ICU length of stay (LOS) and in-hospital LOS were recorded from medical records by a study nurse.[15-17] Hospital mortality was observed, and 28-day mortality was retrieved from the official national database (Statistics Finland, Helsinki, Finland).

Adherence to the routine assessment of the level of sedation and pain was calculated by dividing the frequency of documentation by 24 hours (according to local guidelines, the levels of sedation and pain should be assessed and documented at least once an hour). Adherence to daily sedation interruption was measured by the frequency of daily sedation interruption documentation per sedation day.

Analysis

Demographic and clinical data are presented using frequencies and percentages and medians and quartiles (ie, 25th and 75th percentiles). Percentages are presented as a valid percent. Nonparametric *t* test was used to compare continuous variables. In addition, $\chi 2$ and Fisher exact test was used to compare categorical variables, as appropriate. Predicted hospital mortality was calculated using the APACHE II risk score (Knaus *et al.* 1985). Two-tailed *P* value < 0.05 was considered significant. Statistical analyses were performed using SPSS 21.0 for Windows (IBM Corp. Released 2012. IBM SPSS Statistics for Windows, Version 21.0. Armonk, NY: IBM Corp.).

Ethical considerations

This study was approved by the relevant academic centre, and it was reviewed by the Ethics Committee of Northern Ostrobothnia Hospital District, Oulu University Hospital, Oulu, Finland, during the autumn of 2014. Written informed consent was obtained from the participants, or their next of kin, prior to inclusion in the study (Declaration of Helsinki 2013). Returning of a questionnaire was considered consent to participate in the study among critical care nurses.

RESULTS

The questionnaire was distributed to all available critical care nurses (N = 155). The final response rate was 55.5%. Most respondents were female (85.1%) with a bachelor's degree (67.9%) and a median of 10.0 (5.0-19.3) years of ICU work experience. In addition, 85 patients were included. Most patients were neurosurgical (37.6%), middle-aged (64.0 years, 51.5-72.5), male (69.4%) patients. The median APACHE, SAPS, and SOFA scores at admission were 20.0 (14.0-25.5), 47.0 (36.0-59.0), and 8.0 (6.0-10.0), respectively. The median duration of mechanical ventilation, ICU LOS, and in-hospital LOS were 5.5 (3.0-10.0), 10.7 (5.9-10.7), and 19.5 (11.8-30.2) days. Twenty (*n*=20) patients developed VAP. Hospital mortality was 16.5% with a median predicted hospital mortality of 26.0%, and 28-day mortality was 35.3%.

Lung-protective ventilation

Median tidal volume, Ppeak, and PEEP were 6.0 (5.0-7.0) mL/kg, 19.0 (16.0-21.0) cm H_2O, and 6.0 (5.0-7.0) cm H_2O, respectively. The levels of respiratory settings did not differ between patients with and without VAP (Table 1) or between survivors and nonsurvivors (Table 2). The levels of knowledge of and self-reported adherence to low tidal ventilation were 84.5% and 90.2%, and the median tidal volume was at a target level (6-8 mL/kg) in 74.4% of patients without any group differences (patients with and without VAP, 75.0% vs. 73.8%, p >0.9; survivors and nonsurvivors, 74.5% vs. 73.3%, p > 0.9).

Sedation and analgesia

During the study period, 98.8% of sedatives were administered via continuous infusion with bolus doses if needed. The most commonly used sedatives were nonbenzodiazepines, such as propofol (98.8% of patients) and dexmedetomidine (60.0% of patients); benzodiazepine was less used (midazolam, 42.4% of patients). Quality and level of sedation was assessed with RASS. The median RASS score was -1.0 (-2.5-0.0). The level of RASS scoring did not differ between patients with and without VAP (Table 1) or between survivors and nonsurvivors (Table 2).

The levels of knowledge and self-reported and documented adherence to routine sedation level assessment were 36.9%, 92.0%, and 28.3%, respectively. The total number of RASS assessments documented per sedation day was significantly higher among patients with VAP than among those without VAP (8.1 [6.4-9.9] vs. 6.7 [5.0-8.3], p = 0.02). However, the total number of RASS assessments documented per sedation day did not differ between survivors and nonsurvivors (6.9 [5.7-8.7] vs. 6.5 [4.9-8.2], p = 0.194).

The levels of knowledge and self-reported and documented adherence pertaining to target-controlled sedation were 57.1%, 76.7%, and 71.8%, respectively. Adherence to target-controlled sedation did not differ among patients with and without VAP (71.8% [35.2-92.0] vs. 72.9% [41.2-94.3], $p = 0.733$) or survivors and nonsurvivors (70.9% [38.6-90.9] vs. 83.5 [29.4-95.6], $p = 0.901$).

Regarding daily sedation interruption, the levels of knowledge and self-reported and documented adherence were 85.7%, 77.3%, and 33.3%, respectively, without any group differences (Table 1, Table 2). The main reasons for nonadherence were reported as neurological ($n = 32$ of 54 documented reasons, 59.3%), other reason ($n = 20$ of 66 documented reasons, 30.3%), respiratory ($n = 16$ of 70 documented reasons, 22.9%), and hemodynamical ($n = 16$ of 70 documented reasons, 22.9%). Generally, the reason for nonadherence was documented in 50.0% of the cases without any group differences. In addition, the documentation missing did not differ between the groups.

Patients with VAP had significantly more sedative days than patients without VAP (11.0 [8.3-15.0] vs. 5.0 [3.0-9.5]; $p < 0.001$), and the proportion of days during which nonbenzodiazepine sedatives were used was significantly higher among patients with VAP than among those without VAP (propofol, 8.5 [3.0-9.5] vs. 5.0 [3.0-7.0] $p = 0.001$; dexmedetomidine, 4.5 [0.5-7.0] vs. 2.0 [0.0-4.0] $p = 0.017$) (Table 1), but these differences were not observed between survivors and nonsurvivors (Table 2).

Pain was treated with intravenous opioids, which were administered mostly (61.2%) via continuous infusion with bolus doses if needed. The incidence of pain was assessed with CPOT and/or VRS. The levels of knowledge and self-reported adherence regarding CPOT were 32.1% and 67.7%, whereas the total number of CPOT assessments documented was 2.9 (2.7-3.0) per ICU day demonstrating insufficient adherence to local guidelines (12.1%). The total number of CPOT assessments documented did not differ between patients with and without VAP (2.8 [2.6-3.0] vs. 2.9 [2.8-3.1], $p = 0.082$) or between survivors and nonsurvivors (2.8 [2.7-3.0] vs. 3.0 [2.7-3.1], $p = 0.211$). In addition, the level of pain did not differ between patients with and without VAP (Table 1) or between survivors and nonsurvivors (Table 2).

Evaluation of extubation readiness

The most frequently chosen weaning modes included pressure support ventilation (PSV) with minimal pressure support (65.7%), continuous positive airway pressure (CPAP) (11.9%) and T-tube (11.9%). Weaning modes did not differ between patients with and without VAP (Table 1) or between survivors and nonsurvivors (Table 2). However, the duration of mechanical ventilation was significantly longer in patients with VAP than in those without VAP (9.5 [1.0-15.8] vs. 4.0 [2.3-9.0]; $p = 0.001$). Most of the respondents (82.1%) knew the recommendations related to NIV while self-reported

adherence was 87.2%. However, only 8.2% of the patients received NIV immediately after extubation (Table 1, Table 2). The levels of knowledge and self-reported adherence regarding SBT were 61.9% and 71.6%, respectively.

DISCUSSION

In our study, critical care nurses' knowledge of and self-reported and documented adherence to lung-protective ventilation demonstrated successful implementation of local guidelines. However, in sedation management implementation of guidelines was insufficient; while self-reported adherence to daily sedation interruption, target-controlled sedation, and daily sedation interruption documentation per sedation day was sufficient, the majority of the respondents did not know how often the level of sedation should be assessed and documented nor how deeply patients should ideally be sedated. Adherence to lung-protective ventilation, daily sedation interruption, and daily assessment of readiness to extubate, however, did not differ between patients with and without VAP and between survivors and nonsurvivors.

Lung-protective ventilation including low-tidal ventilation and avoidance of high inspiratory plateau pressures was well implemented and adhered to. In a previous study, the main barriers toward lung-protective ventilation included lack of education, role ambiguity, and lack of knowledge.[20] In line with previous literature, late tracheostomy had no impact on VAP rates.[2] Previously, however, late tracheostomy has been associated with morbidity and mortality. [4]

Self-reported adherence to daily sedation interruption was satisfactory and most respondents knew that sedation should be interrupted daily unless contraindicated. Documented adherence to daily sedation interruption was insufficient without any group differences. The reason for nonadherence was documented only in half of the cases. In previous literature, the main barriers toward daily sedation interruption have consisted of lack of education, fear of potential adverse effects (eg, fear of potential self-extubation and risk for worse psychological outcomes), situation-related barriers, lack of guidelines, inadequate resources, role ambiguity, and patient discomfort (eg, pain, and anxiety associated with lightening sedation).[18-20] The rate of unplanned extubations[19] and long-term psychological effects,[18] however, have not differed between patients with and without sedation or daily sedation interruption.

The levels of sedation and pain were assessed using recommended and validated tools. In accordance with guidelines, the median RASS score was -1.0, demonstrating light sedation. Contrary to self-reported adherence, the levels of knowledge and documented adherence regarding routine sedation level assessment were insufficient. Despite the lack of knowledge, however, self-reported and documented adherence to target-controlled sedation was sufficient. Respondents' knowledge and documented adherence regarding local pain assessment guidelines indicated a significant need for proper implementation in this area. So far, however, the optimal frequency of RASS and CPOT assessment and documentation has not been determined, and guidelines do not provide recommendations even though complications associated with oversedation and unrelieved pain have been well established.

Just over half of the respondents knew that readiness to extubate should be assessed daily (unless contraindicated), whereas 71.6% adhered to SBT. In previous literature, the main barriers toward SBT have been identified as lack of

education, role ambiguity, fear of potential adverse effects, lack of guidelines, disagreement with reported trial results, situation-related barriers, and lack of order.[20] The most frequently chosen weaning mode was PSV with minimal pressure support, whereas in previous literature, the most frequently chosen weaning modes have been CPAP, bilevel positive airway pressure (BIPAP) and PSV.[7]

Over three-fourths of the respondents knew that NIV should be used in appropriate patients to decrease the duration of mechanical ventilation. The majority of the respondents were in favor of NIV, while only a fifth of patients received this treatment prior intubation, and even fewer post extubation. The use of NIV in Europe is generally relatively high, especially among pulmonologists and in acute hypercapnic respiratory failure.[21] However, NIV utilization rate has been higher among pulmonologists than intensivists/anesthesiologists.[21] In previous literature, the main barriers toward NIV have included role ambiguity, lack of education, lack of guidelines, forgetfulness, and lack of outcome expectancy.[20]

Role ambiguities have resulted from the lack of clarity about the nurse's expected role in specific situations as well as from differences between institutional policies and procedures related to the weaning practices. In addition, organization of the units, visible, for example, in time and structure of the ward rounds, staff levels, staff allocation system, increased workload, lack of time, and competing priorities, as well as interprofessional relationships (eg, doctor-nurse relationship, interprofessional communication, the level of autonomy, supportive and collegial working environment, guidance disagreements), have affected ICU nurses' practice. Furthermore, issues of ownership and accountability (eg, lack of skills, confidence and decision autonomy), and the role of the weaning protocols, which may cause role ambiguities in selection of weaning strategy and ventilator settings, have hindered critical care nurses' decision making related to weaning.[22-23]

In the future, more attention should be paid to multidisciplinary decision making and the timing of daily sedation interruption and SBT: morning shifts can be the busiest shifts of the day leading to resource shortage. As indicated in a previous study, more attention should be paid on documentation.[11] In addition, implementational interventions must be tailored according to profession.[9]

This was an observational single-center study with a limited sample size and VAP and mortality rates, which may reduce the generalizability of the results. In addition, our study was not powered to detect differences in our primary or secondary outcome parameters, and no difference was seen between the study groups. Secondly, there was no objective confirmation of the respondents' adherence to daily sedation interruption and SBT in everyday practice due to the lack of reliable documentation. Our findings regarding regular sedation assessment should be interpreted with caution: the assessment of the level of sedation every hour, especially during the nights, is more than what is routinely done in most places around the world. Thirdly, implementation of early mobilization was not evaluated. Fourthly, the response rate

was low, and the documentation was inadequate in some cases (for example, for documented SBT and reasons for nonadherence to daily sedation interruption). Therefore, further studies should focus on combining subjective and objective competency assessments.

Conclusion

Despite the efforts made during the last decades, VAP is still common and associated with high resource utilization without increase in mortality in ICU settings. Although recommendations concerning lung-protective ventilation were well known and adhered to, the levels of knowledge and self-reported adherence versus documented adherence regarding sedation optimization, avoidance of intubation, and assessment of readiness to extubate showed inconsistencies and demonstrated insufficient implementation of local guidelines.

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Highlights

- VAP is still common and associated with high resource utilization.
- Lung-protective ventilation were well known and adhered to.
- Sedation optimization demonstrated insufficient implementation.
- Assessment of readiness to extubate demonstrated insufficient implementation.

Table 1. Clinical characteristics of included patients (*n* = 85).

	Patients with VAP (*n* = 20)	Patients without VAP (*n* = 65)	*P* value [b]
Admission category:			
Surgery, No. (%)	7 (35.0)	16 (24.6)	
Neurosurgery, No. (%)	8 (40.0)	24 (36.9)	
Internal Medicine, No. (%)	4 (20.0)	10 (15.4)	
Oncology, No. (%)	1 (5.0)	0 (0.0)	
Pulmonology, No. (%)	0 (0.0)	4 (6.2)	
Otology, No. (%)	0 (0.0)	1 (1.5)	
Presence of tracheostomy after admission, No. (%)	13 (65.0)	30 (46.2)	
Sedative days, median [a]	11.0 (8.3-15.0)	5.0 (3.0-9.5)	<0.001*
Propofol (mg/kg), median [a]	8.5 (5.3-11.8)	5.0 (3.0-7.0)	0.001*
Dexmedetomidine (mg/kg), median [a]	4.5 (0.5-7.0)	2.0 (0.0-4.0)	0.017*
Midazolam (mg/kg), median [a]	1.0 (0.0-7.5)	0.0 (0.0-3.0)	0.182
RASS, median [a]	-1.5 (-3.0-0.0)	-1.0 (-1.8-0.0)	0.357
CPOT, median [a]	0.0 (0.0-0.0)	0.0 (0.0-0.0)	0.494
VRS, median [a]	0.0 (0.0-0.0)	0.0 (0.0-0.0)	0.471
Ppeak (cm H_2O), median [a]	19.0 (17.0-21.8)	18.5 (16.0-21.0)	0.905
Tidal volume (mL/kg), median [a]	7.3 (5.9-7.7)	7.3 (6.3-8.2)	0.962
PEEP (cm H_2O), median [a]	5.5 (5.0-6.8)	6.0 (5.0-7.0)	0.294
FiO_2, median [a]	38.2 (33.8-44.3)	39.0 (33.6.48.1)	0.551
Ventilator days, median [a]	9.5 (7.0-15.8)	4.0 (2.3-9.0)	0.001*
Daily sedation interruption, median [a]	20.0 (8.4-43.8)	33.3 (16.0-95.0)	0.135
Method for weaning:			0.533
T-tube, No. (%)	2 (10.0)	6 (9.2)	
CPAP, No. (%)	2 (10.0)	6 (9.2)	
PSV with minimal pressure support, No. (%)	10 (50.0)	34 (52.3)	
Intermittent mandatory ventilation, No. (%)	0 (0.0)	7 (10.8)	
No extubation, No. (%)	6 (30.0)	12 (18.5)	
Reintubation, No. (%)	1.0 (0.0-1.8)	0.0 (0.0-1.0)	0.574
Noninvasive ventilation:			
Prior intubation, No. (%)	5 (25.0)	13 (20.0)	0.533
Post extubation, No. (%)	2 (10.0)	5 (7.7)	0.479
Heat and moisture exchanger changed daily, (%)	61.5 (46.6-82.2)	66.5 (50.0-83.3)	0.983
Bronchoscopy, No. (%)	0.0 (0.0-1.8)	0.0 (0.0-1.0)	0.657
Length of ICU stay (days), median [a]	15.7 (12.1-20.6)	9.3 (5.8-14.6)	0.001*
Predicted hospital mortality (%) [c]	30 (10-60)	30 (10-40)	0.474
Hospital mortality (%)	4 (20.0)	10 (15.4)	0.731
28-d mortality (%)	9 (45.0)	21 (32.3)	0.423

Abbreviations: CPAP = continuous positive airway pressure, CPOT = Critical-Care Pain Observation Tool, FiO_2 = fraction of inspired oxygen, ICU = intensive care unit, PEEP = positive end-expiratory pressure, Ppeak = peak inspiratory airway pressure, PSV = pressure-support ventilation, RASS = Richmond Agitation-Sedation Scale, VAP = ventilator-associated pneumonia, VRS = Verbal Rating Scale.
[a] 25th and 75th percentiles
[b] $\chi 2$ or Fisher exact test and independent samples *t* test between the study groups.
[c] Calculated using APACHE II score at admission.

Table 2. Clinical characteristics of survivors and nonsurvivors (28-day mortality).

	Nonsurvivors (n = 30)	Survivors (n = 55)	P value [b]
Admission category:			
Surgery, No. (%)	9 (30.0)	14 (25.5)	
Neurosurgery, No. (%)	7 (23.3)	25 (45.5)	
Internal Medicine, No. (%)	6 (20.0)	8 (14.5)	
Oncology, No. (%)	1 (3.3)	0 (0.0)	
Pulmonology, No. (%)	2 (6.7)	2 (3.6)	
Otology, No. (%)	0 (0.0)	1 (1.8)	
Neurology, No. (%)	5 (16.7)	5 (9.1)	
Presence of tracheostomy after admission, No. (%)	13 (43.3)	13 (23.6)	
Sedative days, median [a]			
Propofol (mg/kg), median [a]	5.0 (3.0-7.8)	5.0 (4.0-8.0)	0.722
Dexmedetomidine (mg/kg), median [a]	1.5 (0.0-3.0)	3.0 (0.0-5.0)	0.099
Midazolam (mg/kg), median [a]	0.0 (0.0-0.0)	0.0 (0.0-5.0)	0.067
RASS, median [a]	-0-5 (-2.6-0.0)	-1.0 (-2.5-0.0)	0.564
CPOT, median [a]	0.0 (0.0-0.0)	0.0 (0.0-0.0)	0.85
VRS, median [a]	0.0 (0.0-0.0)	0.0 (0.0-0.0)	0.216
Ppeak (cm H_2O), median [a]	19.0 (17.0-20.5)	18.5 (16.0-1.0)	0.584
Tidal volume (mL/kg), median [a]	6.9 (6.1-8.6)	7.3 (6.3-7.9)	0.649
PEEP (cm H_2O), median [a]	6.0 (5.0-7.0)	15.0 (5.0-7.0)	0.699
FiO_2, median [a]	39.7 (35.3-48.6)	43.5 (33.9-50.6)	0.575
Ventilator days, median [a]	6.0 (3.0-10.0)	5.0 (3.0-11.25)	0.97
Daily sedation interruption, median [a]	37.5 (19.0-100.0)	27.5 (9.3-54.2)	0.085
Method for weaning:			0.219
T-tube, No. (%)	2 (6.7)	6 (10.9)	
CPAP, No. (%)	4 (13.3)	4 (7.3)	
PSV with minimal pressure support, No. (%)	12 (40.0)	32 (58.2)	
Intermittent mandatory ventilation, No. (%)	2 (6.7)	5 (9.1)	
No extubation, No. (%)	10 (33.3	8 (14.5)	
Reintubation, No. (%)	1.0 (0.0-2.0)	0.0 (0.0-0.0)	0.295
Noninvasive ventilation:			
Prior intubation, No. (%)	8 (26.7)	10 (18.2)	Na
Post extubation, No. (%)	3 (10.0)	4 (7.3)	0.501
Heat and moisture exchanger changed daily, (%)	66.7 (47.5-83.3)	65.1 (50.0-83.3)	0.97
Bronchoscopy, No. (%)	0.5 (0.0-1.25)	0.0 (0.0-1.0)	0.381
Length of ICU stay (days), median [a]	10.3 (5.1-16.8)	10.9 (6.5-16.8)	0.429

Abbreviations: CPAP = continuous positive airway pressure, CPOT = Critical-Care Pain Observation Tool, FiO_2 = fraction of inspired oxygen, ICU = intensive care unit, PEEP = positive end-expiratory pressure, Ppeak = peak inspiratory airway pressure, PSV = pressure-support ventilation, RASS = Richmond Agitation-Sedation Scale, VAP = ventilator-associated pneumonia, VRS = Verbal Rating Scale.
[a] 25th and 75th percentiles
[b] $\chi 2$ or Fisher exact test and independent samples t test between the study groups.