Official Executive Summary of an American Thoracic Society/American College of Chest Physicians Clinical Practice Guideline: Liberation from Mechanical Ventilation in Critically Ill Adults

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This official clinical practice guideline of the American Thoracic Society (ATS) and the American College of Chest Physicians (CHEST) was approved by the ATS Board of Directors, December 2016, and by the CHEST Board of Regents, October 2016

Background: This clinical practice guideline addresses six questions related to liberation from mechanical ventilation in critically ill adults. It is the result of a collaborative effort between the American Thoracic Society and the American College of Chest Physicians.

Methods: A multidisciplinary panel posed six clinical questions in a Population, Intervention, Comparator, and Outcomes format. A comprehensive literature search and evidence synthesis was performed for each question, which included appraising the certainty in the evidence (i.e., the quality of evidence) using the Grading of Recommendations, Assessment, Development, and Evaluation approach. The Evidence-to-Decision framework was applied to each question, requiring the panel to evaluate and weigh the importance of the problem, the confidence in the evidence, the certainty about how much the public values the main outcomes, the magnitude and balance of desirable and undesirable outcomes, the resources and costs associated with the intervention, the impact on health disparities, and the acceptability and feasibility of the intervention.

Results: Evidence-based recommendations were formulated and graded initially by subcommittees and then modified after full-panel discussions. The recommendations were confirmed by confidential electronic voting; approval required that at least 80% of the panel members agree with the recommendation.

Conclusions: The panel provides recommendations regarding liberation from mechanical ventilation. The details regarding the evidence and rationale for each recommendation are presented in the *American Journal of Respiratory and Critical Care Medicine* and *Chest*.

Contents

This Executive Summary is one component of an official ATS/CHEST clinical practice guideline; the Summary is being simultaneously published in the *American Journal of Respiratory and Critical Care Medicine* and in *Chest* (volume 151, pages 160–165). The guideline also consists of two other articles that contain detailed discussions of questions. The first set of discussions (inspiratory pressure augmentation during spontaneous breathing trials, protocols minimizing sedation, and noninvasive ventilation immediately after extubation) is being published in *Chest* (volume 151, pages 166–180); the second set (rehabilitation protocols, ventilator liberation protocols, and cuff leak tests) is published in this issue of *AJRCCM* (pages 120–133).

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Am J Respir Crit Care Med Vol 195, Iss 1, pp 115–119, Jan 1, 2017

Originally Published in Press as DOI: 10.1164/rccm.201610-2076ST on October 20, 2016
Internet address: www.atsjournals.org

Introduction

Mechanical ventilation is essential for many critically ill adults; however, it also is associated with numerous complications and patient discomfort. In an effort to facilitate liberation from mechanical ventilation, the American Thoracic Society (ATS) and the American College of Chest Physicians (CHEST) collaboratively developed evidence-based recommendations that address common clinical questions. The goal of the guidelines is to help clinicians safely and effectively liberate patients from mechanical ventilation and improve outcomes among critically ill patients.

Guidelines cannot take into account all of the often compelling unique individual clinical circumstances. Clinicians are not expected to adhere to these recommendations blindly or universally. However, these unbiased, evidence-based guidelines may provide support to clinicians who manage these vulnerable patients and have questioned the efficacy of selected methods for ventilator liberation.

Methods

Six co-chairs were appointed, three each by the ATS and CHEST leadership, and reviewed for credentials and possible conflicts of interest. The six co-chairs (ATS: T.D.G., P.E.M., and J.D.T.; CHEST: J.P.K., D.R.O., and G.A.S.) suggested panelists to the ATS and CHEST staff, who invited, reviewed for potential conflicts of interest, and, finally, approved them. The final panel consisted of the six co-chairs, eight pulmonary/critical care physicians, four critical care physicians, one critical care nurse, one physical therapist, and one critical care pharmacist. There were also two methodologists, one of whom is also a critical care physician. The panelists were divided among six topic groups as content experts for their particular area of expertise.

The six co-chairs proposed six clinical questions, which were vetted and confirmed by the panel. Outcomes for each question were weighted following an approach outlined by the Grading Recommendations, Assessment, Development, and Evaluation (GRADE) Working Group. After comprehensive evidence synthesis of published manuscripts, the panel used the GRADE approach to assess the overall certainty of the evidence for each question's associated outcomes. The Evidence-to-Decision framework facilitated panel deliberation and recommendation development (1, 2). Each recommendation was considered strong or conditional (Table 1) and required at least 80% panel consensus for approval. Any recommendation not meeting this threshold was revised based on panel feedback and resubmitted for vote.

Results

ATS and CHEST elected to share publication of the guideline, which consists of six questions and the related evidence syntheses and recommendations (Table 2). After appropriate review by ATS and

Table 1. Implications of Recommendations by Stakeholders

Implications for	Strong Recommendation	Conditional Recommendation
Patients	Most individuals in this situation would want the recommended course of action, and only a small proportion would not.	The majority of individuals in this situation would want the suggested course of action, but many would not.
Clinicians	Most individuals should receive the intervention. Adherence to this recommendation according to the guideline could be used as a quality criterion or performance indicator. Formal decision aids are not likely to be needed to help individuals make decisions consistent with their values and preferences.	Recognize that different choices will be appropriate for individual patients and that you must help each patient arrive at a management decision consistent with his or her values and preferences. Decision aids may be useful in helping individuals to make decisions consistent with their values and preferences.
Policy makers	The recommendation can be adopted as policy in most situations.	Policy making will require substantial debate and involvement of various stakeholders.

Table 2. Summary of Recommendations

Recommendation	Strength of Recommendation	Certainty in the Evidence (i.e., Quality of Evidence)
1. For acutely hospitalized patients ventilated >24 h, we suggest that the initial SBT be conducted with inspiratory pressure augmentation (5–8 cm H_2O) rather than without (T-piece or CPAP).	Conditional	Moderate certainty in the evidence
2. For acutely hospitalized patients ventilated >24 h, we suggest protocols attempting to minimize sedation.	Conditional	Low certainty in the evidence
3. For patients at high risk for extubation failure who have been receiving mechanical ventilation for >24 h, and who have passed a spontaneous breathing trial, we recommend extubation to preventive NIV.	Strong	Moderate certainty in the evidence
4. For acutely hospitalized patients who have been mechanically ventilated for >24 h, we suggest protocolized rehabilitation directed toward early mobilization.	Conditional	Low certainty in the evidence
5. We suggest managing acutely hospitalized patients who have been mechanically ventilated for >24 h with a ventilator liberation protocol.	Conditional	Low certainty in the evidence
6a. We suggest performing cuff leak test in mechanically ventilated adults who meet extubation criteria and deemed high risk for PES.	Conditional	Very low certainty in the evidence
6b. For adults who have failed a cuff leak test but are otherwise ready for extubation, we suggest administering systemic steroids at least 4 h before extubation. A repeat cuff leak test is not required.	Conditional	Moderate certainty in the evidence

Definition of abbreviations: CPAP = continuous positive airway pressure; NIV = noninvasive ventilation; PES = postextubation stridor; SBT = spontaneous breathing trial.
More detailed discussions of questions 1–3 appear in *Chest* (3) and of questions 4–6 appear in the *American Journal of Respiratory and Critical Care Medicine* (4).

CHEST leadership, the guidelines are published as three manuscripts: an executive summary and two manuscripts that address three questions each. The panel made recommendations but did not support specific protocols for any of the six questions. One of two manuscripts is published in *Chest* (3) and the other in the *American Journal of Respiratory and Critical Care Medicine* (4). Both are accompanied by this executive summary.

Question 1: In Acutely Hospitalized Patients Ventilated More Than 24 Hours, Should the Spontaneous Breathing Trial Be Conducted with or without Inspiratory Pressure Augmentation?

The evidence suggested that conducting the spontaneous breathing trial (SBT) with pressure augmentation was more likely to be successful, produced a higher rate of extubation success, and was associated with a trend toward lower intensive care unit (ICU) mortality than SBTs performed without pressure augmentation.

ATS/CHEST recommendation. For acutely hospitalized patients ventilated more than 24 hours, we suggest that the initial SBT be conducted with inspiratory pressure augmentation (5–8 cm H_2O) rather than without (T-piece or continuous positive airway pressure) (conditional recommendation, moderate certainty in the evidence).

Remarks. This recommendation relates to how to conduct the initial SBT but does not inform how to ventilate patients between unsuccessful SBTs.

Values and preferences. This recommendation places a high value on reducing the duration of mechanical ventilation and maximizing the probability of extubation success.

Question 2: In Acutely Hospitalized Patients Ventilated for More Than 24 Hours, Do Protocols Attempting to Minimize Sedation Compared with Approaches That Do Not Attempt to Minimize Sedation Impact Duration of Ventilation, Duration of ICU Stay, and Short-Term Mortality (60 d)?

The evidence showed a trend toward a shorter duration of mechanical ventilation, a shorter ICU length of stay, and a trend toward lower short-term mortality in the protocolized sedation group.

ATS/CHEST recommendation. For acutely hospitalized patients ventilated for more than 24 hours, we suggest protocols attempting to minimize sedation (conditional recommendation, low certainty in the evidence).

Remarks. There is insufficient evidence to recommend any protocol over another.

Values and preferences. This recommendation places a high value on reducing mechanical ventilation duration, ICU length of stay, and short-term mortality and views the burden of protocolized sedation as very low.

Question 3: In High-Risk Patients Receiving Mechanical Ventilation for More Than 24 Hours Who Have Passed an SBT, Does Extubation to Preventive Noninvasive Ventilation Compared with No Noninvasive Ventilation Have a Favorable Effect on Duration of Ventilation, Ventilator-Free Days, Extubation Success (Liberation > 48 h), Duration of ICU Stay, Short-Term Mortality (60 d), or Long-Term Mortality?

In studies of preventive noninvasive ventilation (NIV), there was heterogeneity

in defining the high-risk patient. Risk factors included older age, comorbidities such as chronic obstructive pulmonary disease or congestive heart failure, and hypercapnia during the SBT. The evidence synthesis indicated that preventive NIV was superior to no preventive NIV regarding extubation success, ICU length of stay, and both short- and long-term mortality.

ATS/CHEST recommendation. For patients at high risk for extubation failure who have been receiving mechanical ventilation for more than 24 hours, and who have passed an SBT, we recommend extubation to preventive NIV (strong recommendation, moderate certainty in the evidence).

Remarks. Patients at high risk for failure of extubation may include those patients with hypercapnia, chronic obstructive pulmonary disease, congestive heart failure, or other serious comorbidities. Physicians may choose to avoid extubation to NIV in selected patients for patient-specific factors, including but not limited to the inability to receive ventilation through a mask or similar interface. Physicians who choose to use NIV should apply such treatment immediately after extubation to realize the outcome benefits.

Values and preferences. This recommendation places a high value on early extubation and a lesser value on the burdens related to institution and maintenance of preventive NIV.

Question 4: Should Acutely Hospitalized Adults Who Have Been Mechanically Ventilated for More Than 24 Hours Be Subjected to Protocolized Rehabilitation Directed toward Early Mobilization or No Protocolized Attempts at Early Mobilization?

The evidence synthesis demonstrated that patients who received an intervention directed toward early mobilization had a shorter duration of mechanical ventilation and were more likely to be able to walk at hospital discharge. There were no differences in mortality, ICU length of stay, ability to walk at ICU discharge, 6-minute-walk distance, or ventilator-free days. Low rates of serious adverse events, including arrhythmias, have been reported.

ATS/CHEST recommendation. For acutely hospitalized adults who have been mechanically ventilated for more than 24 hours, we suggest protocolized rehabilitation directed toward early mobilization (conditional recommendation, low certainty in the evidence).

Remarks. There is insufficient evidence to recommend any rehabilitation protocol over another.

Values and preferences. This recommendation places a high value on reducing the duration of mechanical ventilation and maintenance of ambulation and a lower value on cost and resource use.

Question 5: Should Acutely Hospitalized Adults Who Have Been Mechanically Ventilated for More Than 24 Hours Be Managed with a Ventilator Liberation Protocol or No Protocol?

The guideline panel defined a "ventilator liberation protocol" as protocol-guided efforts to identify a patient's readiness for liberation (i.e., extubation) from invasive mechanical ventilation. The evidence demonstrated that patients managed with a ventilator liberation protocol spent fewer hours on mechanical ventilation than did patients managed without a protocol. In addition, management with a ventilator liberation protocol led to being discharged from the ICU earlier than management without a protocol. However, ventilator liberation protocols had no significant effect on mortality or reintubation rates. Adverse events were rarely reported. Subgroup analyses found that, compared with management without a ventilator liberation protocol, personnel-driven and computer-driven protocols had similar effects.

ATS/CHEST recommendation. We suggest managing acutely hospitalized adults who have been mechanically ventilated for more than 24 hours with a ventilator liberation protocol (conditional recommendation, low certainty in the evidence).

Remarks. The ventilator liberation protocol may be either personnel driven or computer driven.

Values and preferences. This recommendation places a high value on reducing the duration of mechanical ventilation and ICU length of stay and a lower value on resource use.

Question 6a: Should a Cuff Leak Test Be Performed before Extubation of Mechanically Ventilated Adults? Question 6b: Should Systemic Steroids Be Administered to Adults Who Fail a Cuff Leak Test before Extubation?

The evidence suggested that patients with an absent or insufficient cuff leak are at increased risk of postextubation stridor (PES) and unsuccessful extubation. Very-low-quality evidence also suggested that the use of a cuff leak test (CLT) to guide management may decrease the reintubation and PES rate and delay extubation (due to high false-positive rate). It has no effect on the duration of mechanical ventilation when considering the additional days associated with reintubation. Moderate-quality evidence suggested that administration of systemic steroids to patients failing a CLT may reduce both the reintubation and PES rates. Patients passing a CLT have a low risk of reintubation and PES, although these risks are also low among patients extubated without having a CLT performed.

ATS/CHEST recommendations.

1. We suggest performing a CLT in mechanically ventilated adults who meet extubation criteria and are deemed high risk for PES (conditional recommendation, very low certainty in the evidence).
2. For adults who have failed a CLT but are otherwise ready for extubation, we suggest administering systemic steroids at least 4 hours before extubation (conditional recommendation, moderate certainty in the evidence).

Remarks. Risk factors for PES include: traumatic intubation, intubation longer than 6 days, large endotracheal tube, female sex, and reintubation after unplanned extubation. A repeat CLT is not required after the administration of systemic steroids.

Values and preferences. These recommendations place a high value on avoiding reintubation and delayed extubation and a lower value on PES, the burdens related to implementing the CLT, and the side effects of steroid use.

Summary

The recommendations in these guidelines are the result of our expert panel's

interpretation of the existing evidence and how it may be applied in clinical practice. Only one recommendation, extubation to preventive noninvasive mechanical ventilation in high-risk patients, is strongly suggested. All others are considered conditional recommendations and include: conducting SBTs with inspiratory pressure augmentation, using protocols to minimize sedation, using protocolized rehabilitation directed toward early mobilization, using ventilator liberation protocols, performing a CLT in mechanically ventilated patients who meet extubation criteria and are deemed high risk for PES, and administering systemic steroids at least 4 hours before extubation in patients who fail a CLT. A repeated CLT is not required. ■

This official clinical practice guideline was prepared by an ATS/CHEST *ad hoc* committee on liberation from mechanical ventilation in adults.

Members of the committee are as follows:

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Author Disclosures: T.D.G. received honoraria from Hospira Inc. and served on a data and safety monitoring board for ALung Technologies Inc. J.P.K. was a speaker for Hospira Inc. D.R.O. receives research support from Cardeas Pharmaceutical and has provided expert testimony on the subject of venous thromboembolic disease. G.A.S. received research support from Spectral Diagnostics, has stock or stock options with Johnson & Johnson, and received royalties from UpToDate. J.D.T. received research support from AstraZeneca and served on a data and safety monitoring board for Spiration. S.K.E. receives royalties from UpToDate and Wolters Kluwer. E.F. received research support from Nihon Kohden and was a speaker for ALung Technologies Inc. W.D.S. received research support from Hill-Rom. C.N.S. has noncommercialized intellectual property: patent "Prevention of Ventilator Associated Pneumonia" and patent pending for "Automated Detection of Incomplete Exhalation for Adults on Invasive Mechanical Ventilations"; copyright held by Virginia Commonwealth University for "Richmond Agitation-Sedation Scale"; and has stocks or stock options in Baxter, Johnson & Johnson, Merck, and Pfizer (family member, independently managed). P.E.M., W.A., S.M.B., A.E., M.F., G.L.F., M.N.G., C.L.H., S.M., R.N., S.P., A.J.P., T.S., and K.C.W. reported no relationships with relevant commercial interests.

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