CHEST

Liberation From Mechanical Ventilation in Critically Ill Adults

Executive Summary of an Official American College of Chest Physicians/American Thoracic Society Clinical Practice Guideline

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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 (ATS) and the American College of Chest Physicians (CHEST).

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

RESULTS: Evidence-based recommendations were formulated and graded initially by subcommittees and then modified following 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*.

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KEY WORDS: evidence-based medicine; guidelines; mechanical ventilation

ABBREVIATIONS: ATS = American Thoracic Society; CHEST = American College of Chest Physicians; CLT = cuff leak test; GRADE = Grading of Recommendations, Assessment, Development, and Evaluation; NIV = noninvasive ventilation; PES = postextubation stridor; SBT = spontaneous breathing trial

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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 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 cochairs were appointed, three each by the ATS and CHEST leadership, and reviewed for credentials and possible conflicts of interest. The six cochairs (T. D. G., P. E. M., J. D.T. from ATS and J. P. K., D. R. O., and G. A. S. from CHEST) suggested panelists to the ATS and CHEST staff, who then invited and reviewed them for potential conflicts of interest and finally approved them. The final panel consisted of the six cochairs, eight pulmonary/critical care physicians, four critical care physicians, one critical 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 cochairs 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 the ATS and 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.

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This Executive Summary is an overview of the official ATS/CHEST clinical practice guideline. It is being simultaneously published in *Chest* and the *American Journal of Respiratory and Critical Care Medicine*.

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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.	Clinicians should recognize that different choices will be appropriate for individual patients and that one 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.

Question 1: In acutely hospitalized patients ventilated more than 24 h, should the spontaneous breathing trial (SBT) be conducted with or without inspiratory pressure augmentation?

The evidence suggested that conducting the 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 ICU mortality than SBTs performed without pressure augmentation.

CHEST/ATS Recommendation

1. For acutely hospitalized patients ventilated more than 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 Recommendation, Moderate-Quality 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 h, do protocols attempting to minimize sedation compared with approaches that do not attempt to minimize sedation impact duration of

TABLE 2] Summary of Recommendations

Recommendation	Strength of Recommendation	Certainty of Evidence (ie, Quality of Evidence)
1. For acutely hospitalized patients ventilated more than 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 for more than 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 more than 24 h and who have passed am SBT, 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 a CLT in mechanically ventilated adults who meet extubation criteria and are deemed at high risk for PES	Conditional	Very low certainty in the evidence
6b. For adults who have failed a CLT but are otherwise ready for extubation, we suggest administering systemic steroids at least 4 h before extubation; a repeated CLT is not required	Conditional	Moderate certainty in the evidence

More detailed discussions of questions 1-3 appear in Ouellette et al[3] and of questions 4-6 appear in Girard et al.[4] CLT = cuff leak test; NIV = noninvasive ventilation; PES = postextubation stridor; SBT = spontaneous breathing trial.

ventilation, duration of ICU stay, and short-term mortality (60 days)?

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.

CHEST/ATS Recommendation

2. For acutely hospitalized patients ventilated for more than 24 h, we suggest protocols attempting to minimize sedation (Conditional Recommendation, Low-Quality 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 h who have passed an SBT, does extubation to preventive noninvasive ventilation (NIV) compared with no NIV have a favorable effect on duration of ventilation, ventilator-free days, extubation success (liberation > 48 h), duration of ICU stay, short-term mortality (60 days), or long-term mortality?

In studies of preventive NIV, there was heterogeneity in defining the high-risk patient. Risk factors included older age, comorbidities such as COPD 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.

CHEST/ATS Recommendation

3. For patients at high risk for extubation failure who have been receiving mechanical ventilation for more than 24 h and who have passed an SBT, we recommend extubation to preventive NIV (Strong Recommendation, Moderate Quality Evidence).

Remarks: Patients at high risk for failure of extubation may include those patients with hypercapnia, COPD, 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 >24 h 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-min walk distance, or ventilator-free days. Low rates of serious adverse events, including arrhythmias, have been reported.

ATS/CHEST Recommendation

4. For acutely hospitalized adults who have been mechanically ventilated for > 24 h, we suggest protocolized rehabilitation directed toward early mobilization (Conditional Recommendation, Low Quality 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 > 24 h 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 (ie, 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. Additionally, management with a ventilator

liberation protocol led to patients 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

5. We suggest managing acutely hospitalized adults who have been mechanically ventilated for > 24 h with a ventilator liberation protocol (Conditional Recommendation, Low-Quality 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 6: Should a cuff leak test (CLT) be performed prior to extubation of mechanically ventilated adults? Should systemic steroids be administered to adults who fail a CLT prior to 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 CLT to guide management may decrease the reintubation and PES rate and delay extubation (due to a 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

6a. 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).

6b. For adults who have failed a CLT but are otherwise ready for extubation, we suggest administering systemic steroids at least 4 h before extubation; a repeated CLT is not required (Conditional Recommendation, Moderate-Quality Evidence).

Remarks: Risk factors for PES include traumatic intubation, intubation > 6 days, large endotracheal tube, female sex, and reintubation after unplanned extubation. A repeat CLT is not required following 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 at high risk for PES, and administering systemic steroids at least 4 h prior to extubation in patients who fail a CLT. A repeat CLT is not required.

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