Extubation in ED

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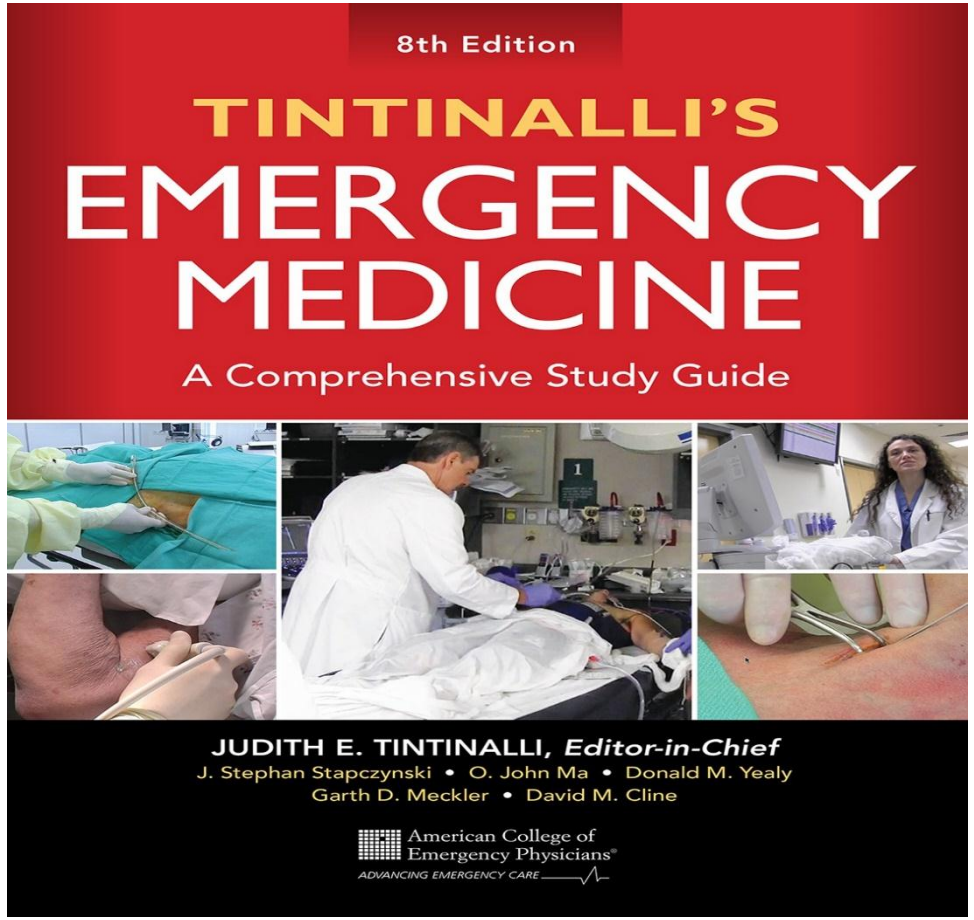
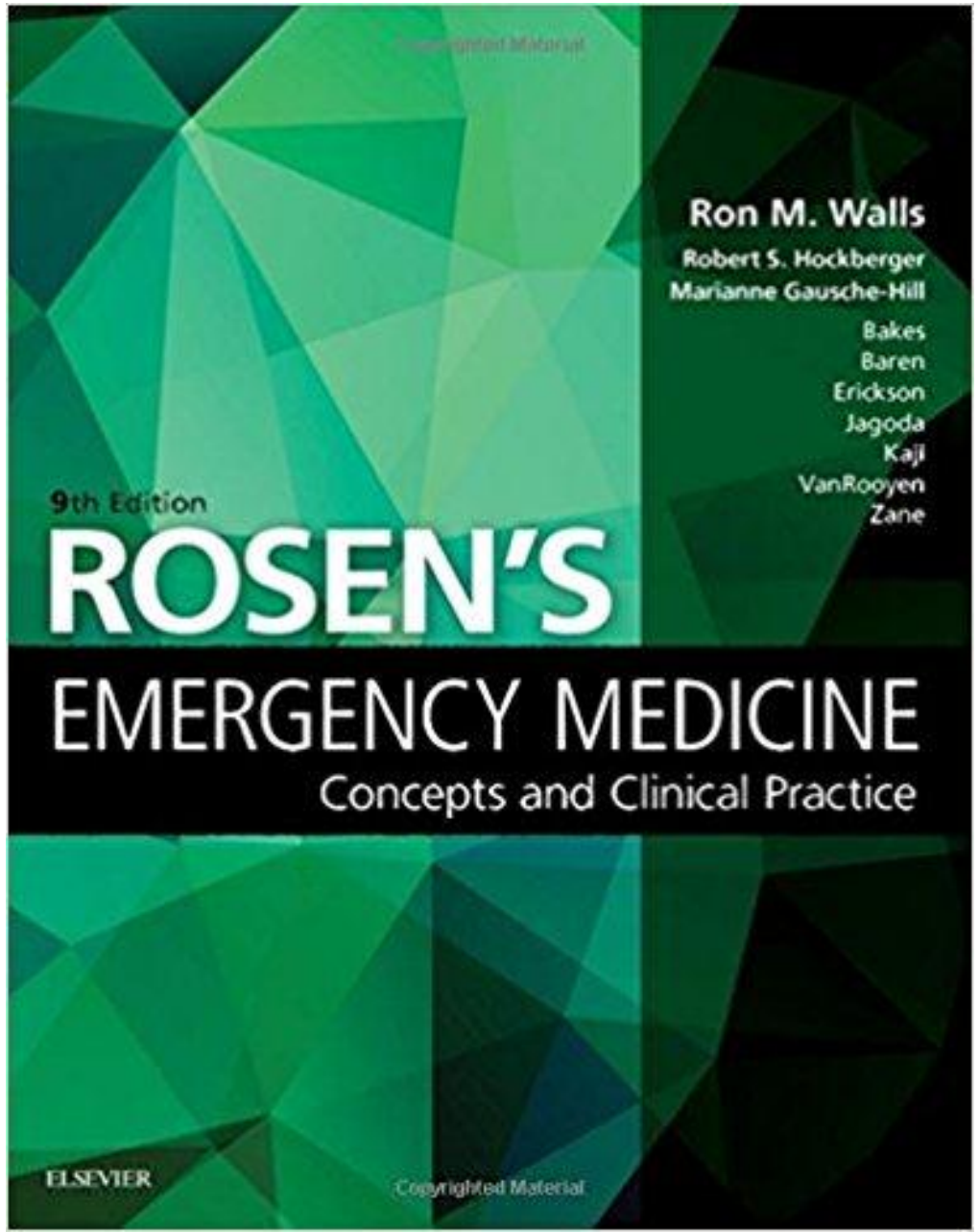


- This maneuver is not common in the ED but may be required in settings of rapid recovery or after prolonged ED care.



those for patients with COPD, with small notable differences. In acute asthma, respiratory failure is a result of airway obstruction and airway inflammation. Furthermore, unlike COPD, airway obstruction is much less dynamic and occurs predominantly in the large airways. In addition, acute inflammatory changes throughout the lung contribute to decreased lung compliance, which has a direct impact on lung pressures during ventilation. Strategies should focus on low respiratory rates, with emphasis on maximizing expiratory time. The use of PEEP has been debated and is largely thought to contribute to increased lung pressure. Although no studies have definitively supported VCV over PCV, decreased lung compliance and potential iPEEP may make the delivery of adequate tidal volumes with PCV difficult. This is especially problematic for patients with severe, acute respiratory acidosis, for whom adequate ventilation is essential. Recommendations for ventilator settings include VCV with tidal volumes of 6 to 8 mL/kg IBW, respiratory rate of 10 to 15 breaths/min, and little (5 cm H_2O) or no PEEP. Decreased inspiratory time allows greater expiratory time and, in VCV, is achieved by increasing the inspiratory flow rate. Increases in inspiratory flow rate, however, will increase airway pressures, emphasizing the interplay of inspiratory time, tidal volume, and airway pressure.

Acute Respiratory Distress Syndrome

ARDS represents a spectrum of inflammatory lung disease characterized by heterogeneous noncardiogenic pulmonary edema, hypoxia, and diffuse lung consolidation. The severity of ARDS is

OUTCOMES

Because of the heterogeneity of ventilation strategies and clinical reasons for respiratory failure, no studies have shown the superiority of one ventilation method over another; considerations in initiating mechanical ventilation are individualized and serially reevaluated. Nonetheless, certain conclusions regarding outcomes can be made. Data have clearly indicated the effectiveness of NPPV in preventing intubation for patients with COPD and ACPE, and these benefits have resulted in decreased admission to the ICU and decreased mortality. In addition, increased alveolar volumes and pressures have been shown to contribute to VILI and increase mortality in patients with ARDS. Although the benefit of decreased tidal volume ventilation on the prevention of lung injury in patients with normal lungs has not been proven, emerging data have suggested that strategies of mechanical ventilation in the ED can improve the subsequent clinical course of critically ill patients.

Finally, although the treatment of mechanically ventilated patients usually extends beyond the ED, delays in ICU admission can have significant implications on ED management of the critically ill ventilated patient because the role of emergency clinicians extends beyond acute stabilization toward ongoing clinical management.[42] In addition, when boarding times are long, patients intubated solely for airway protection may be candidates for extubation in the ED if the initial insult has been reversed.

KEY CONCEPTS


TOP GLOVE
50
Dräger
Dräger
Mavita


Dräger
Agila
27,4
Hill-Rom


Hill-Rom

- > 15 % patients need reintubation within 48 hours.*
- Reintubation=> longer ICU stays

  longer length of hospitalization

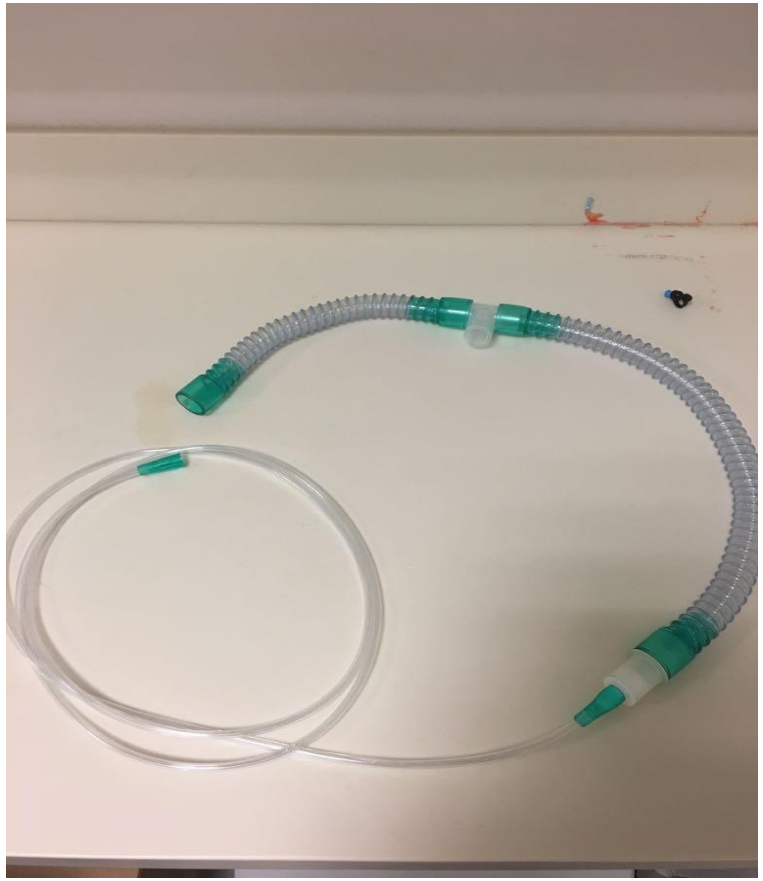
  need for long-term care

  ↑rates of morbidity and mortality
- If reintubation rate is ≈0 => patients may be exposed to ↑ risk of ventilator lung injury.

**MacIntyre NR, Cook DJ, Ely EW Jr, et al. Evidencebased guidelines for weaning and discontinuing ventilatory support: a collective task force facilitated by the American College of Chest Physicians; the American Association for Respiratory Care; and the American College of Critical Care Medicine. Chest 2001;120:375S–95S.*

Spontaneous Breathing Trial (SBT)

- Using a T-Piece or Pressure Support (PS) of 5 cmH2O => 120 min/day



SBT

- Patient must be conscious, sedation must be stopped before the attempt
- Patient must be heamodynamically stable => shock Ø

  MI Ø

  dysrythmia Ø

  pH >7,35

  the need of dopamine/dobutamine < 5 µg/kg/min

Criteria Used in Several Large Trials To Define Tolerance of an SBT

- Gas exchange acceptability (Spo2 ? 85–90%; Po2 ? 50–60 mm Hg; pH ? 7.32; increase in Paco2 ? 10 mm Hg);
- Hemodynamic stability (HR ? 120–140 beats/min; HR not changed ? 20%; systolic BP ? 180– 200 and ? 90 mm Hg; BP not changed ? 20%, no pressors required)
- Stable ventilatory pattern (*eg*, RR ? 30–35 breaths/min; RR not changed ? 50%) Change in mental status (*eg*, somnolence, coma, agitation, anxiety);
  Onset or worsening of discomfort
  Diaphoresis
- Signs of increased work of breathing (use of accessory respiratory muscles, and thoracoabdominal paradox)

Parameters using for weaning

- Respiratory rate (RR)
- Minute ventilation
- Maximal inspiratory pressure (MIP)
- Rapid shallow breathing index (RSBI)

- MIP =>NIF (negative inspiratory rate)

Occluding a manometer to the end of the ETT

and ask the patient to inhale deeply

=> MIP >-20 cmH20

- RSBI => f/TV > 105 breaths/min
- Useful in predicting failure to wean.

Cuff Leak Test (CFL)

- The cuff of the ETT is deflated and the presence of air leak around the tube
- If there is no air leak => laryngeal edema
- CFL may be affected => ETT's size

  Patient's airway size

  Duration of intubation

  Upper airway trauma

  Cough ±

Spontaneous Awakening Trial (SAT)

- Stopping the iv analgesics
  sedations
  neuromuscular blockades
- A => Awakening
- B =>Breathing
- C => Coordination
- D => Delirium treatment
- E => Early mobilization

Diaphragm Thickening Fraction (DTF)

- $\frac{\text{Thickness at the end-inspiration - thickness at the end-expiration}}{\text{thickness at the end-expiration}}$

↓ DTF → ↑ duration of MV

↑ ICU stay

↑ Mortality

Intensive Care Med (2017) 43:29–38
DOI 10.1007/s00134-016-4524-z

SYSTEMATIC REVIEW

Assessment of diaphragmatic dysfunction in the critically ill patient with ultrasound: a systematic review

Massimo Zambon[1*], Massimiliano Greco[2], Speranza Bocchino[2], Luca Cabrini[2], Paolo Federico Beccaria[2] and Alberto Zangrillo[2,3]

Abstract

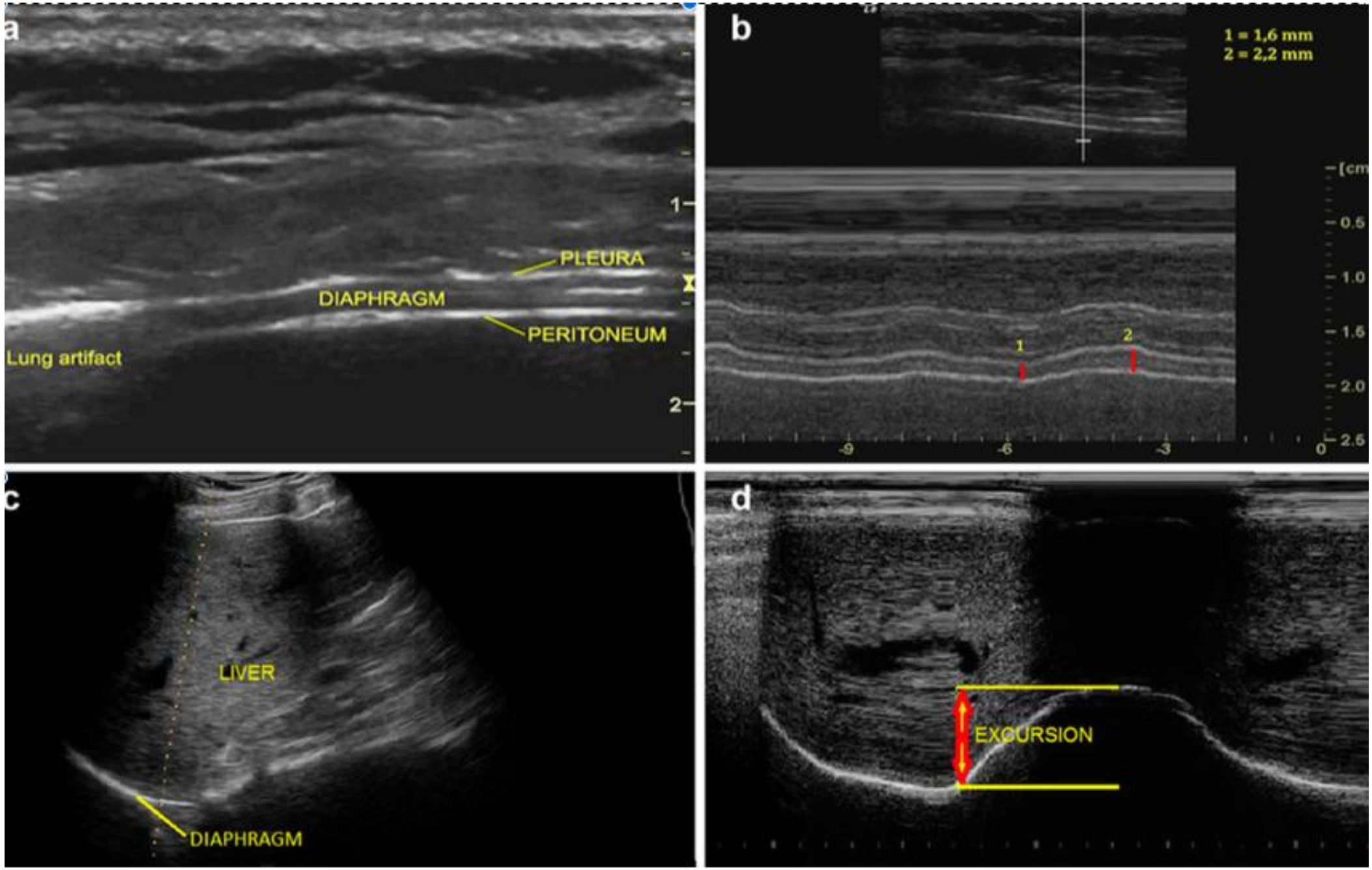
Purpose: Diaphragmatic dysfunction (DD) has a high incidence in critically ill patients and is an under-recognized cause of respiratory failure and prolonged weaning from mechanical ventilation. Among different methods to assess diaphragmatic function, diaphragm ultrasonography (DU) is noninvasive, rapid, and easy to perform at the bedside. We systematically reviewed the current literature assessing the usefulness and accuracy of DU in intensive care unit (ICU) patients.

Methods: Pubmed, Cochrane Database of Systematic Reviews, Embase, Scopus, and Google Scholar Databases were searched for pertinent studies. We included all original, peer-reviewed studies about the use of DU in ICU patients.

Results: Twenty studies including 875 patients were included in the final analysis. DU was performed with different techniques to measure diaphragmatic inspiratory excursion, thickness of diaphragm (Tdi), and thickening fraction (TF). DU is feasible, highly reproducible, and allows one to detect diaphragmatic dysfunction in critically ill patients. During weaning from mechanical ventilation and spontaneous breathing trials, both diaphragmatic excursion and diaphragmatic thickening measurements have been used to predict extubation success or failure. Optimal cutoffs ranged from 10 to 14 mm for excursion and 30–36 % for thickening fraction. During assisted mechanical ventilation, diaphragmatic thickening has been found to be an accurate index of respiratory muscles workload. Observational studies suggest DU as a reliable method to assess diaphragm atrophy in patients undergoing mechanical ventilation.

Conclusions: Current literature suggests that DU could be a useful and accurate tool to detect diaphragmatic dysfunction in critically ill patients, to predict extubation success or failure, to monitor respiratory workload, and to assess atrophy in patients who are mechanically ventilated.

Keywords: Diaphragm, Ultrasonography, Diaphragmatic dysfunction, Thoracic ultrasound, Respiratory monitoring, Critically ill



g. 1 Diaphragm ultrasonography (DU) at the zone of apposition in **a** B-mode, **b** M-mode. *1* Thickness at end expiration, *2* thickness at end inspira
on. DU, right subcostal in **c** B-mode, **d** M-mode

Diaphragm and Lung Ultrasound to Predict Weaning Outcome

Systematic Review and Meta-Analysis

Ana M. Llamas-Álvarez, MD; Eva M. Tenza-Lozano, MD, PhD; and Jaime Latour-Pérez, MD, PhD

BACKGROUND: Deciding the optimal timing for extubation in patients who are mechanically ventilated can be challenging, and traditional weaning predictor tools are not very accurate. The aim of this systematic review and meta-analysis was to assess the accuracy of lung and diaphragm ultrasound for predicting weaning outcomes in critically ill adults.

METHODS: MEDLINE, the Cochrane Library, Web of Science, Scopus, LILACS, Teseo, Tesis Doctorales en Red, and OpenGrey were searched, and the bibliographies of relevant studies were reviewed. Two researchers independently selected studies that met the inclusion criteria and assessed study quality in accordance with the Quality Assessment of Diagnostic Accuracy Studies-2 tool. The summary receiver-operating characteristic curve and pooled diagnostic OR (DOR) were estimated by using a bivariate random effects analysis. Sources of heterogeneity were explored by using predefined subgroup analyses and bivariate meta-regression.

RESULTS: Nineteen studies involving 1,071 people were included in the study. For diaphragm thickening fraction, the area under the summary receiver-operating characteristic curve was 0.87, and DOR was 21 (95% CI, 11-40). Regarding diaphragmatic excursion, pooled sensitivity was 75% (95% CI, 65-85); pooled specificity, 75% (95% CI, 60-85); and DOR, 10 (95% CI, 4-24). For lung ultrasound, the area under the summary receiver-operating characteristic curve was 0.77, and DOR was 38 (95% CI, 7-198). Based on bivariate meta-regression analysis, a significantly higher specificity for diaphragm thickening fraction and higher sensitivity for diaphragmatic excursion was detected in studies with applicability concerns.

CONCLUSIONS: Lung and diaphragm ultrasound can help predict weaning outcome, but its accuracy may vary depending on the patient subpopulation.

CHEST 2017; 152(6):1140-1150

APACHE II Score 0-71

- APACHE II >20 ➔ failure in weaning*
- APACHE II >12 ➔ failure in weaning**

- SOFA Score 0-24

*Matic I, Titlic M, Dikanovic M, Jurjevic M, Jukic I, Tonkic A. *Effects of APACHE II score on mechanical ventilation; prediction and outcome. Acta Anaesthesiol Belg. 2007; 58(3): 177-83. PMID: 18018838.*

** McConville JF, Kress JP. Weaning Patients from the Ventilator. N Engl J Med. 2012; 367: 2233-9. doi: 10.1056/NEJMra1203367, PMID: 23215559.

Burns Wean Assesment Program (BWAP)

BWAP > 90 ➔ succesful weaning *

- Morganroth Scale

  21 variables are evaluated every 3 days

  Not predict the failure or succes of weaning**

- Gluck and Corgian Scoring System > 3 ➔ failure in weaning **

Table 1. Gluck and Corgian Scoring System

Indices	0	1	2
RSBI (f/vt)	< 120	120-180	> 180
VD/VT	<0.64	0.64-0.74	0.74>
Compl (st)	> 36	32-36	< 32
Resistance	< 9	9-17	> 17
$PaCo_2$		> 64	

VD/VT: dead space to tidal volume ratio, Compl (st): static lung compliance, Resistance: airway resistance

*Burns SM, Fisher C, Tribble SS, Lewis R, Merrel P, Conaway MR, et al. Multifactor Clinical Score and Outcome of Mechanical Ventilation Weaning Trials: Burns Wean Assessment Program. Am J Crit Care. 2010; 19(5): 431-9. doi: 10.4037/ajcc2010273, PMID: 20810418.

**Gluck EH, Corgian L. Predicting Eventual Success or Failure to Wean in Patients Receiving Long-term Mechanical Ventilation1. Chest. 1996; 110(4): 1018-24. doi: 10.1378/chest.110.4.1018.

AMERICAN THORACIC SOCIETY DOCUMENTS

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

Rehabilitation Protocols, Ventilator Liberation Protocols, and Cuff Leak Tests

Background: Interventions that lead to earlier liberation from mechanical ventilation can improve patient outcomes. This guideline, a collaborative effort between the American Thoracic Society and the American College of Chest Physicians, provides evidence-based recommendations to optimize liberation from mechanical ventilation in critically ill adults.

Methods: Two methodologists performed evidence syntheses to summarize available evidence relevant to key questions about liberation from mechanical ventilation. The methodologists appraised the certainty in the evidence (i.e., the quality of evidence) using the Grading of Recommendations, Assessment, Development, and Evaluation approach and summarized the results in evidence profiles. The guideline panel then formulated recommendations after considering the balance of desirable consequences (benefits) versus undesirable consequences (burdens, adverse effects, and costs), the certainty in the evidence, and the feasibility and acceptability of various interventions. Recommendations were rated as strong or conditional.

Results: The guideline panel made four conditional recommendations related to rehabilitation protocols, ventilator liberation protocols, and cuff leak tests. The recommendations were for acutely hospitalized adults mechanically ventilated for more than 24 hours to receive protocolized rehabilitation directed toward early mobilization, be managed with a ventilator liberation protocol, be assessed with a cuff leak test if they meet extubation criteria but are deemed high risk for postextubation stridor, and be administered systemic steroids for at least 4 hours before extubation if they fail the cuff leak test.

Conclusions: The American Thoracic Society/American College of Chest Physicians recommendations are intended to support healthcare professionals in their decisions related to liberating critically ill adults from mechanical ventilation.

Question 1: 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?

- 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).

Question 3a: Should a Cuff Leak Test Be Performed before Extubation of Mechanically Ventilated Adults? Question 3b: Should Systemic Steroids Be Administered to Adults Who Fail a Cuff Leak Test before Extubation?

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

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	Conditional	Moderate certainty in the evidence

Systematic Review

The role of non-invasive ventilation used immediately after planned extubation for adults with chronic respiratory disorders

Results: Eight studies enrolling 736 patients were included in the meta-analysis. Compared with general oxygen therapy, NIV used immediately after planned extubation in patients with chronic respiratory disease reduced the reintubation rate (p=0.02), ventilator-associated pneumonia (VAP) incidence rate (p=0.000), and ICU mortality (p=0.002) and increased the level of PO2 (p=0.03).

Conclusion: Non-invasive ventilation used immediately after planned extubation seems to be advantageous for decreasing the reintubation rate, VAP incidence, and ICU death rate in patients with chronic respiratory disease.

Saudi Med J 2018; Vol. 39 (2):131-136
doi: 10.15537/smj.2018.2.21942

JAMA | Original Investigation | CARING FOR THE CRITICALLY ILL PATIENT

Effect of Postextubation High-Flow Nasal Cannula vs Noninvasive Ventilation on Reintubation and Postextubation Respiratory Failure in High-Risk Patients
A Randomized Clinical Trial

- **INTERVENTIONS** Patients were randomized to undergo either high-flow conditioned oxygen therapy or NIV for 24 hours after extubation.
- **MAIN OUTCOMES AND MEASURES** Primary outcomes were reintubation and postextubation respiratory failure within 72 hours. Noninferiority margin was 10 percentage points. Secondary outcomes included respiratory infection, sepsis, and multiple organ failure, length of stay and mortality; adverse events; and time to reintubation.
- **CONCLUSIONS AND RELEVANCE** Among high-risk adults who have undergone extubation, high-flow conditioned oxygen therapy was not inferior to NIV for preventing reintubation and postextubation respiratory failure. High-flow conditioned oxygen therapy may offer advantages for these patients.

- *JAMA. 2016;316(15):1565-1574. doi:10.1001/jama.2016.14194*

Crit Care Nurs Q
Vol. 40, No. 2, pp. 165–177

Factors Influencing Weaning Older Adults From Mechanical Ventilation

An Integrative Review

This study aim was to describe the influences that affect weaning from mechanical ventilation among older adults in the intensive care unit (ICU). Adults older than 65 years comprised only 14.5% of the US population in 2014; however, they accounted up to 45% of all ICU admissions. As this population grows, the number of ICU admissions is expected to increase. One of the most common procedures for hospitalized adults 75 years and older is mechanical ventilation. weaned from mechanical ventilation. Age, in and of itself, is not a predictor or determinant of weaning from mechanical ventilation. Of the 6 studies reviewed, all identified various predictors of weaning outcomes, which included maximal inspiratory pressure, RSBI, fluid balance, comorbidity burden, severity of illness, emphysematous changes, and low serum albumin. By understanding the factors

Cough augmentation techniques for extubation or weaning critically ill patients from mechanical ventilation (Review)

Rose L, Adhikari NKJ, Leasa D, Fergusson DA, McKim D.
Cough augmentation techniques for extubation or weaning critically ill patients from mechanical ventilation.
Cochrane Database of Systematic Reviews 2017, Issue 1. Art. No.: CD011833.

Review question

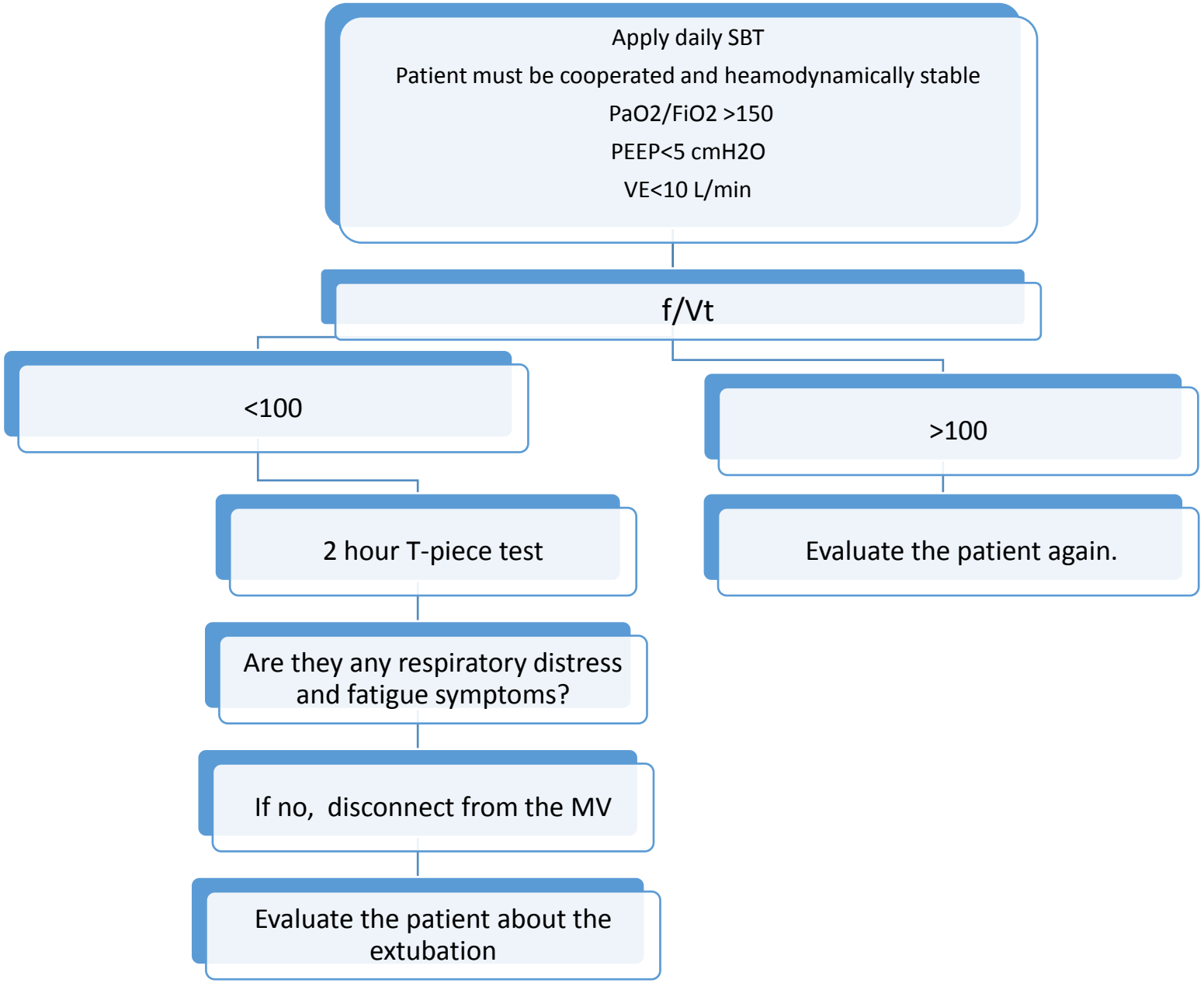
Do techniques that promote cough in mechanically-ventilated, critically-ill adults and children in a high-intensity care setting improve rates of successful extubation and weaning?

Conclusions

Very low-quality evidence from single trial findings suggests that cough-promoting techniques might increase successful removal of the breathing tube and decrease the time spent on mechanical ventilation, while not causing harm. The limited participant numbers made it difficult to determine the likelihood of harms.

Failure in weaning

- Poor parenchymal lung function
- Ventilator-induced-diaphragmatic dysfuntion (VIDD) => begin within hours of MV
- Neuromuscular blockade
- Heavy sedation
- Shock
- Malnutrition
- Systemic inflammation
- Electrolyte disturbance
- Poor cardiovascular function


Apply daily SBT
Patient must be cooperated and heamodynamically stable
PaO2/FiO2 >150
PEEP<5 cmH2O
VE<10 L/min
f/Vt
<100
>100
2 hour T-piece test
Evaluate the patient again.
Are they any respiratory distress and fatigue symptoms?
If no, disconnect from the MV
Evaluate the patient about the extubation

Questions & additions

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