Weaning from Mechanical Ventilation: Principles

- The need for mechanical ventilation implies all of the following:
  - The patient has suffered a life-threatening condition requiring mechanical support of the respiratory system as a whole
  - The patient lacks the respiratory muscle strength or coordination to sustain airway patency, secretion clearance, and adequate gas exchange

Liberation from mechanical ventilation implies all of the following:
- The patient’s condition is improving
- The patient has the respiratory muscle strength and coordination to sustain airway patency, secretion clearance, and adequate gas exchange

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Requirements to Consider Liberation from Mechanical Ventilation

- Adequate oxygenation (p/f ratio is >150; SaO2 >90% on less than 5 peep, FiO2 <50%)
- Hemodynamic stability (SBP 90-180, low dose pressors)
- Afebrile (T< 38C, 100.4F)
- No significant respiratory acidosis (pH>7.25)
- Adequate hemoglobin (hgb > 7 without bleeding)
- Adequate mentation (can protect airway, normal mentation not required)
- Electrolyte stability (Na, K, Mg, Phos)
- Resolution of primary pathology (stable to improving CXR, predictable clinical course)
Daily Sedation Vacation

- NEJM 2000 Kress, et al
- Daily sedation interruption shortened weaning times
  - Reduced ventilation days by 2
  - Reduced ICU days by 2.5

Crit Care Med. 2008
ABC Trial: Daily sedation interruption decreased vent days, shorter ICU stay
Daily sedation interruption became standard of care for those patients requiring mechanical ventilation

Anaesth Intensive Care. 2011 May;39(3):401-9
Meta Analysis
Daily sedation interruption significantly reduced the need for tracheostomy, and was safe. No decrease in ventilation days was noted however which is attributed to varied study methods.

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Daily Sedation Vacation – updated

- JAMA 2012; ePub online October 17, 2012.
- Multicenter, randomized controlled trial
- Daily sedation interruption resulted in increased total doses of midazolam and fentanyl, due to larger boluses of sedation after interruption
- A sizeable (though statistically insignificant) group of patients self-extubated
- No difference in incidence of delirium
- Nursing staff reported increased workload (using standard scale)
- No improvement in ventilation days or ICU days

Takehome:
- Sedation on mechanically-ventilated patients should be titrated to the minimum effective doses
- This study’s control group targeted “light sedation,” which is superior to standard therapy
- Daily sedation interruption is not useful in weaning protocols targeting light sedation and may be harmful
- Setting new sedation targets is likely more important than that daily sedation vacation

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Spontaneous Breathing Trial

- Yang and Tobin described the Rapid Shallow Breathing Index (RSBI)
- Compared several weaning parameters in their ability to predict successful liberation from mechanical ventilation
- RSBI Termed “integrative index” that combines more than one weaning parameter
- RSBI or F/Vt, is defined by the frequency of spontaneous respirations divided by the unsupported average tidal volume (L)
- > 105 is strongly predictive of failure to successfully liberate from mechanical ventilation
- Sensitivity (0.97), Specificity (0.64).
SBT should be the initial weaning strategy for most patients with acute respiratory failure

- SBT vs IMV - Relative rate of successful weaning 2.83
- SBT vs PSV - Relative rate of successful weaning 2.05
- SBT vs intermittent PSV trials – Relative rate of successful weaning 1.24
SBT should be the initial weaning strategy for most patients with acute respiratory failure

- Randomized controlled trial of 300 patients receiving mechanical ventilation
- Daily assessment and 2 hr SBT vs daily assessment and clinical decision to extubate
- Daily SBT shortened length of mechanical ventilation by 1.5 days
- Daily SBT lowered the cost of ICU care by $5,100

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Weaning guidelines: Chest. 2001;120(6_suppl):375S-396S

• “It also appears that whether the SBT is performed with low levels of CPAP (eg, 5 cm H2O), low levels of pressure support (eg, 5 to 7 cm H2O), or simply as “T-piece” breathing has little effect on outcome.”
Extubation and the Myth of Minimal Ventilator Settings

• Tobin, M. American Journal of Respiratory and Critical Care Medicine in 2012 "Extubation and the myth of minimal ventilator settings."

• Each 5 cm pressure support reduces work of breathing by 1/3

• The addition of 5 cm PEEP reduces work of breathing by up to 40%

• Minimal ventilator settings may overestimate the number of patients that can be successfully extubated IE, to err on the side of early extubation

• T-tube trials may underestimate the number of patients that could otherwise be successfully extubated but cannot pass the T-tube trial.
T-Tube VS Minimal Vent Support and Weaning Outcomes

- Multicenter, prospective randomized controlled trial
- T-tube vs 7 cmH2O Pressure Support
- Failure was more frequent with T-tube than PSV (22 vs 14%)
- No difference in rate of re-intubation
- Re-intubation was associated with higher mortality
- Pressure Support is a suitable method for weaning from mechanical ventilation

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PS vs T-tube – final word

- 2014 Cochrane Database Systematic Review
- All RCT’s involving the use of PS vs T-tube for spontaneous breathing trials
- 9 RCT’s involving 1200 patients
- Found generally low-quality studies showing little difference in the methods
- Trend toward superiority of PS over T-tube for uncomplicated weaning trials
A Comparison of Four Methods of Weaning Patients from Mechanical Ventilation

• Patients were randomized to 1 of 4 weaning methods:
  – 1. IMV, with initial rate set at 10, decreasing the rate twice a day
  – 2. PSV, with initial PS 18, decreasing PS twice a day
  – 3. intermittent spontaneous breathing trials 2+ times a day
  – 4. once daily SBT

• The median length of weaning for each method
  – IMV – 5 days
  – PSV - 4 days
  – Intermittent SBT 3 days
  – Once daily SBT 3 days

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Predicting Failure in patients who have passed an SBT

- 15% of patients who pass SBT will require re-intubation within 48 hours.
- Incidence is higher in Neuro and Medical ICU’s.
- Incidence highest in the patient with the following:
  - Ineffective cough
  - Excessive secretions
  - Altered mental status
  - Other factors include older age, stridor, CHF, hypercapnea, failure of 2 previous SBT.

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Placement of tracheostomy tube
American College of Chest Physicians 2001

• After failure of several SBT’s and relative ventilator stability consider whether the patient will benefit from tracheostomy tube placement due to one or more of the following:
  – Those requiring high levels of sedation to tolerate translaryngeal tubes
  – Those with marginal respiratory mechanics (often manifested as tachypnea) in whom a tracheostomy tube having lower resistance might reduce the risk of muscle overload
  – Those who may derive psychological benefit from the ability to eat orally, communicate by articulated speech, and experience enhanced mobility
  – Those in whom enhanced mobility may assist physical therapy efforts

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