

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

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 $< 38^{\circ}\text{C}$, 100.4°F)
- 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.



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 daily sedation vacation

Spontaneous Breathing Trial

- N Engl J Med. 1991 May 23;324(21):1445-50
- 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/V_t , 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**
- **Esteban A, Frutos F, Tobin MJ et al. NEJM 1995; 332:345.**

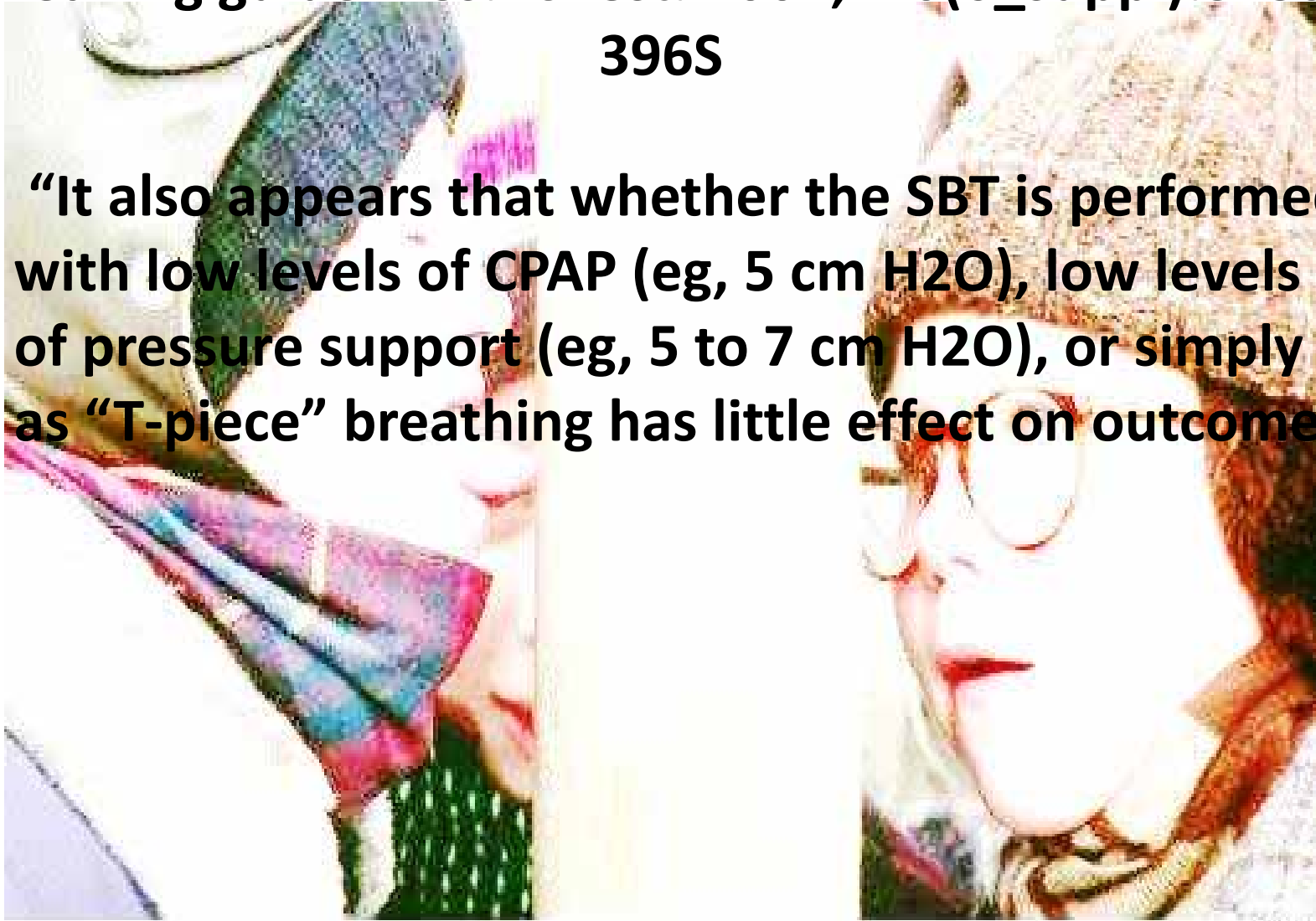
SBT should be the initial weaning strategy for most patients with acute respiratory failure

- **Ely EW, Baker AM, et al. NEJM. 1996; 335(25): 1864.**
- **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**

Worth

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.”**

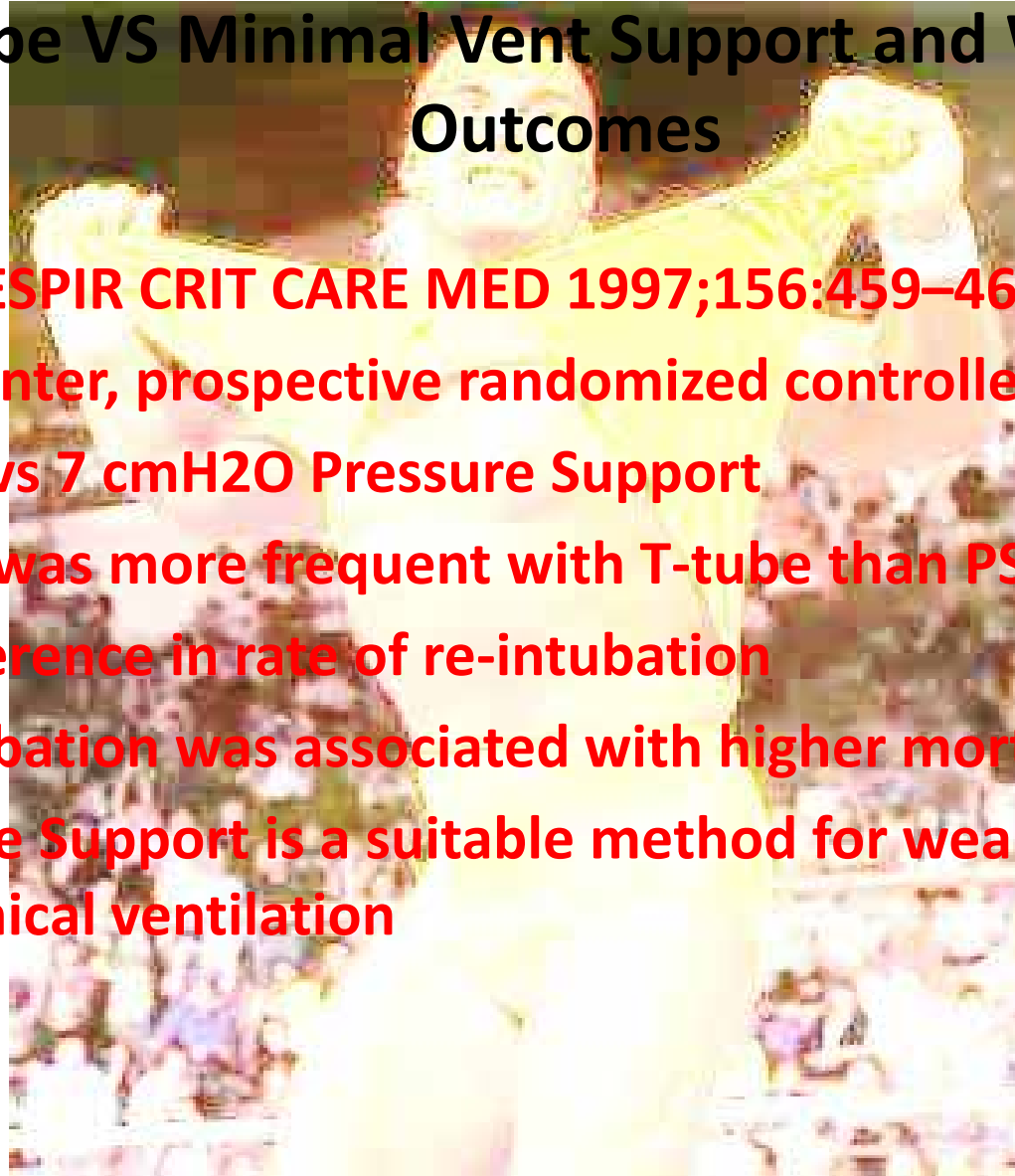


MGM

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



- **AM J RESPIR CRIT CARE MED 1997;156:459–465.**
- **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**

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

- N Engl J Med 1995; 332:345-350 February 9, 1995
- 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

Predicting Failure in patients who have passed an SBT

- **Intensive Care Med. 2004 Jul;30(7):1334-9.**
- **15% of patients who pass SBT will require re-intubation within 48hours**
- **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**

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