

# 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  $>150$ ; SaO<sub>2</sub>  $>90\%$  on less than 5 peep, FiO<sub>2</sub>  $<50\%$ )
- Hemodynamic stability (SBP 90-180, low dose pressors)
- Afebrile (T  $< 38^{\circ}\text{C}$ ,  $100.4^{\circ}\text{F}$ )
- 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

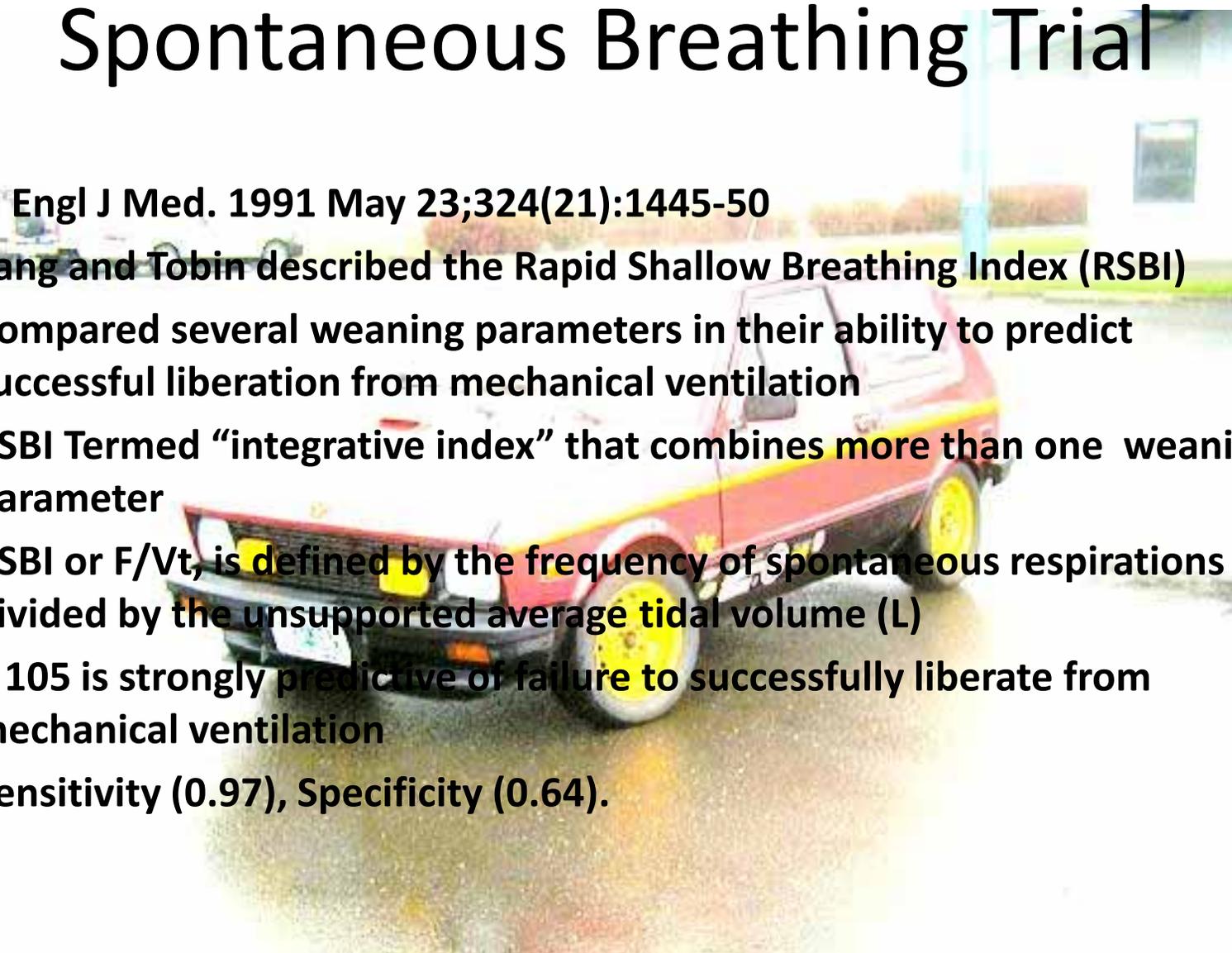
Daily sedation interruption significantly reduced the need for tracheostomy, and was safe. No decrease in ventilation days was noted however which is attributed to varied study methods.



# 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

A red and yellow taxi cab is parked on a street. The car is a hatchback with a yellow stripe along the side. The background shows a building and some trees.

- 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.**

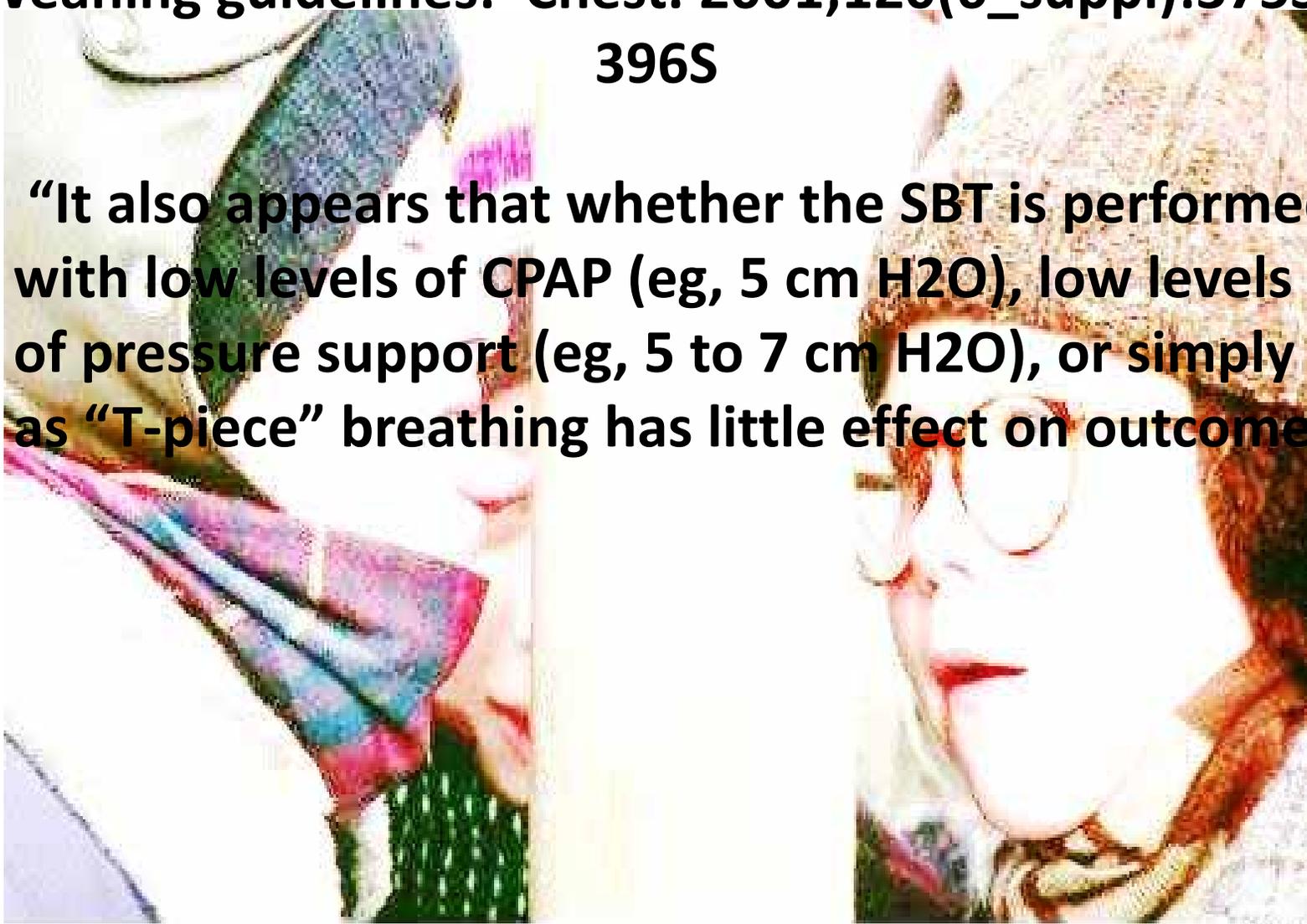
# **SBT should be the initial weaning strategy for most patients with acute respiratory failure**

- **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 H<sub>2</sub>O), low levels of pressure support (eg, 5 to 7 cm H<sub>2</sub>O), 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 cmH<sub>2</sub>O 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