

# Strategies That Encourage Spontaneous Ventilation

Terry L. Forrette, M.H.S., RRT

## Strategies That Encourage Spontaneous Ventilation



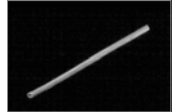
**Are we making a difference?**

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## 1st Published Scientific Paper on Mechanical Ventilation

*"But that life may ... be restored to the animal, an opening must be attempted in the trunk of the trachea, in which a tube of reed or cane should be put; you will then blow into this, so that the lung may rise again and the animal take in air. ... And as I do this, and take care that the lung is inflated in intervals, the motion of the heart and arteries does not stop..."*

Andreas Wesele Vesalius, 1543

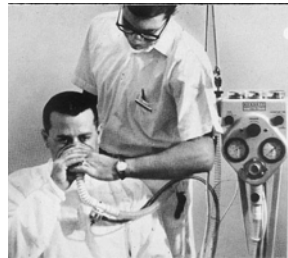


## Evolution of Volume Ventilation



Hook - 1600s

Fell-O'Dwyer Device (1888)



**Ventilation Gets Hi-Tech**



Look How Far We Come. So What's Next On The Horizon?



## Overview of Presentation



"OK, Frank, that's enough. I'm sure the Jeffersons are quite amused at your car headlight device."

- Review of Literature
- Weaning Concepts
- Gas Delivery Systems
- Ventilation Strategies

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## McMaster & Task Force Report

- Search for the causes of ventilator dependence after 24 hours of support
- Discontinuing support - What criteria should be assessed?
- Conducting spontaneous breathing trial (SBT)
- Strategies for those who fail a SBT
- Weaning & discontinuation protocols

## The Double Edged Sword

- Aggressive philosophy will maximize the withdrawal of support but can lead to frequent reintubations.
- Less aggressive protocols result in fewer reintubations but may prolong ventilatory support.
- Factors effected by reintubation need to be considered as does prolonged ventilatory support.

## Clinical Assessment

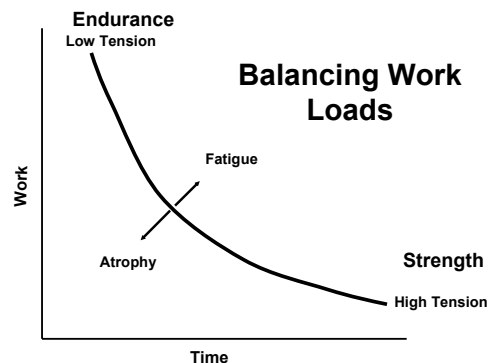
### On Ventilator

- $V_E$  200 mL/kg IBW
- NIF > -20 to -30
- $P_{0.1}$  < -2 to -4 cmH<sub>2</sub>O
- WOBp < .75 J/L
- CROP score 13

### Spontaneous

- RR 24 - 38 br/min
- $V_T$  5 - 7 mL/kg IBW
- f/VT < 105 br/L
- WOBp < .75 J/L
- Patient comfort

Create an image of where the patient should be in terms of their underlying disease process



## What Is Weaning?

- Weaning is not extubation.
- Weaning is transferring the WOB
- Weaning is to optimize respiratory function.
- And to be taken off the mechanical ventilator is the final goal.

**Weaning is not normally an issue!**

## Spontaneous Breathing Trials (SBT)



- Unassisted support?
  - T piece, CPAP
  - PSV, TC(ATC)
- Safety concerns
  - Respiratory muscle fatigue, discomfort
  - Hemodynamic instability
  - Deteriorating gas exchange
- SBT duration time

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## When a SBT Fails

- Determine the cause of failure
  - Gas exchange or  $DO_2$
  - Muscle fatigue or weakness
  - Metabolic or neurologic
- Conduct SBT at least every 24 hours
- Initiate partial ventilatory support modes (PVS)



"Well, the Parkers are dead... You had to encourage them to take thirds, didn't you?"

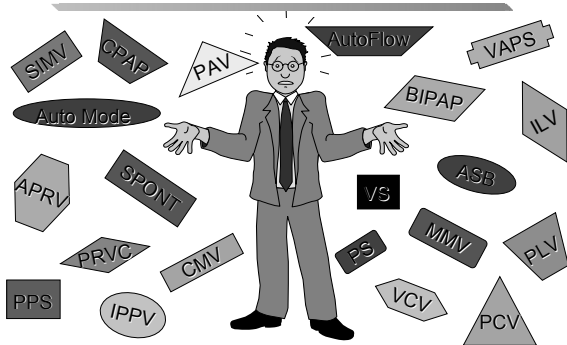
## Protocols - Do they make a difference?



"Well, here's your problem, Marge—if you and Bob really want kids, read time by utter' on these little guys."

- Physician or HCP executed
- Impact on clinical outcomes
  - 1.5 reduction
- Cost factors
  - Reducing cost by \$5,000
- Is there a "universal protocol"?
  - customized
  - flexibility
  - not a panacea

## What About New Modes?



## Assisted Ventilation Breath Types

### Pressure Constant Assisted Ventilation

- PC
- PS
- BiPAP
- BiLevel/APRV

### Volume Constant Assisted Ventilation

- Volume using CMV or SIMV
- Dual Modes
  - PRVC, ASV, VV+ MMV, AutoFlow,

**PAV/PPS & TC**

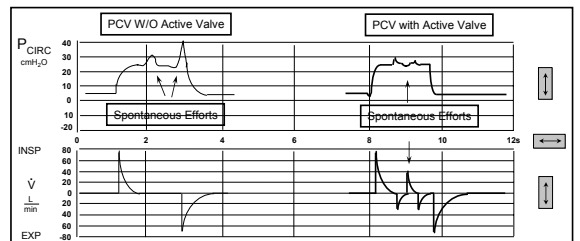
## New Generation of Gas Delivery Systems



- Active exhalation valves
- Overcoming imposed WOB
- Tailoring breath delivery

## Active Exhalation Valve

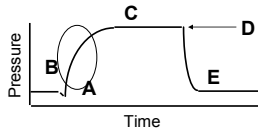
- During inspiration, the valve is closed with the force of the insp pressure setting
- Allows coughing or spont breathing at upper pressure level by venting excess pressure and flow



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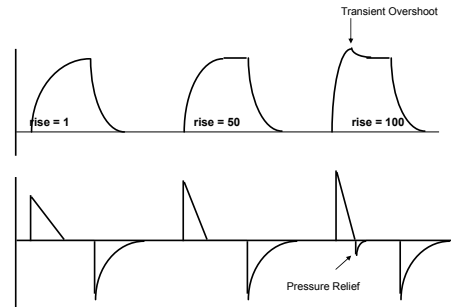
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## The ABC's of Breath Delivery



- A- work to trigger
- B- rise time
- C- preventing pressure overshoot and sustaining the breath
- D- transition into expiration
- E- expiratory resistance

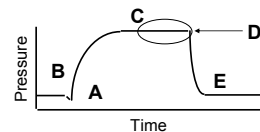
## % Rise Time



## Setting Rise Time

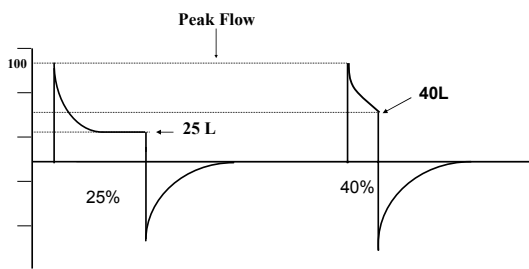
- Monitor volume delivery
- For patients with increased flow demand use higher rise time
- Obstructive patients may be more comfortable with lower Rise time
- Use  $f/V_T$ ,  $P_{0.1}$ , and observe for signs of dysynchrony via graphics

## The ABC's of Breath Delivery



- A - work to trigger
- B - rise time
- C - preventing pressure overshoot and sustaining the breath
- D - transition into exhalation
- E - expiratory resistance

## Expiratory Sensitivity ( $E_{Sens}$ ) %



## Selecting Termination Criteria

- Improving patient - ventilator interaction
  - decrease work of breathing
  - increase synchrony
- Adjusting inspiratory time
  - pediatric patients and restrictive conditions- decrease
  - obstructive airway disease- increase
  - use  $f/V_T$  and  $P_{0.1}$ , and ventilator graphics to monitor dysynchrony.

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## Assisted Ventilation Breath Types

### Pressure Constant Assisted Ventilation

- PC
- PS
- BiPAP
- BiLevel/APRV

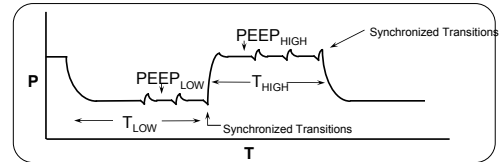
### Volume Constant Assisted Ventilation

- Volume using CMV or SIMV
- Dual Modes
- VS/MMV/ASV

PAV/PPS & TC

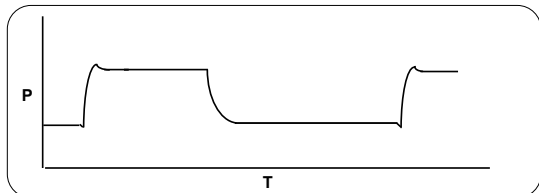
## What is BiLevel/APRV?

- Cycling between the two pressure levels can be synchronized to patient breathing
  - predetermined time or triggered by patient effort
- The two pressure levels are called PEEP<sub>H</sub> and PEEP<sub>L</sub>
- The two timing levels are T<sub>H</sub> and T<sub>L</sub>



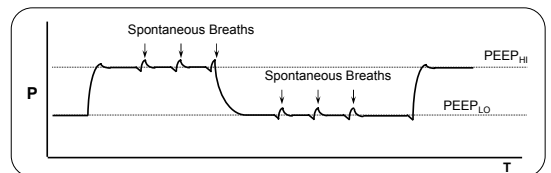
## What Is BiLevel?

- Similar to PCV if there is no spontaneous breathing



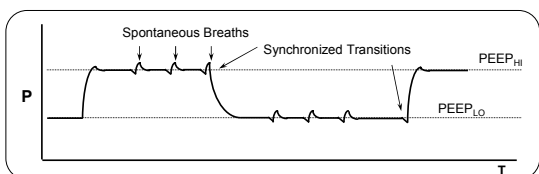
## What Is BiLevel?

- Similar to PCV if there is no spontaneous breathing
- Substantial improvements for spontaneous breathing
  - allows spontaneous breathing at both levels



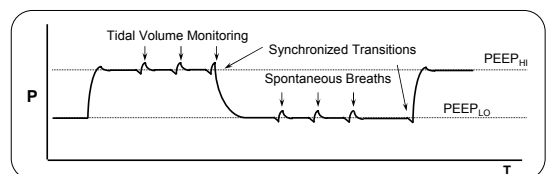
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  - tidal volume monitoring of upper spont breathing

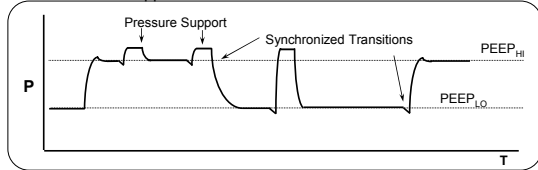


# Strategies That Encourage Spontaneous Ventilation

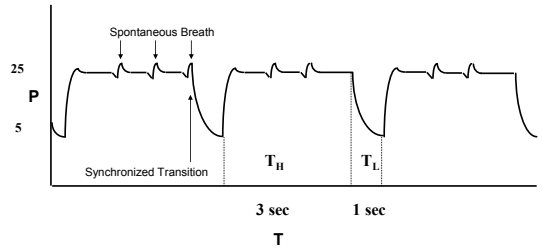
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## What Is BiLevel?

- Similar to PCV if there is no spontaneous breathing
- Substantial improvements for spontaneous breathing
  - allows spontaneous breathing at both levels
  - better synchronization
  - tidal volume monitoring of upper spont breathing
  - more options for supporting spontaneous breathing at the upper level



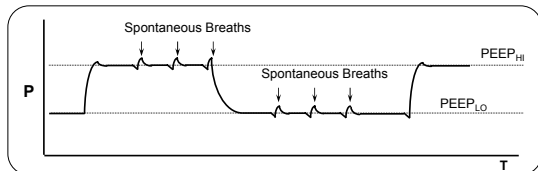
## BiLevel Or APRV?



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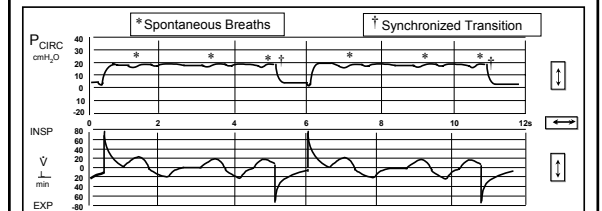
- The "real" difference is one of terminology
- Original mode called APRV
- Inverse I:E = APRV or BiLevel if normal

### Does It Make A Difference?



## Clinical Advantages And Research

- Results in maintenance of lung volume with a lower PIP, and higher FRC at similar MAP (CPAP w/ release)
- Better cardiovascular performance (intrathoracic pump)



## Clinical Advantages To Spontaneous Breathing At 2 PEEP Levels

- A potential decrease in sedation
  - improved respiratory muscle function
  - less interaction with other organ function
  - patients can be mobilized easier
  - an active cough may improve secretion removal
- Masking situations can often lead to problems

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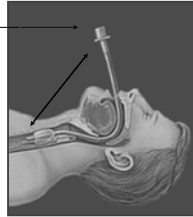
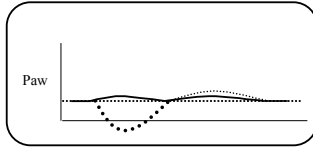
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## What The Carina Sees...

PSV is very efficient in reducing the WOB, but what is the best level to use?

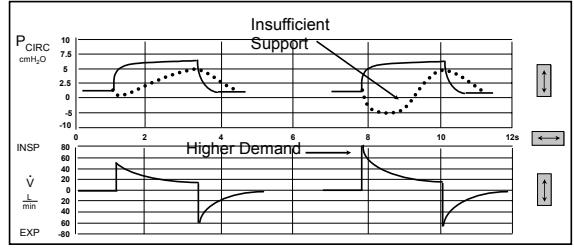
Lower Carina Pressure .....



Pressure drop shows imposed work across ET-Tube when flow is present

## PS Limitations for ETT Compensation

- PS is often used to overcome ET-tube resistance
- PS may under support the WOB early in the inspiratory phase when flows are high

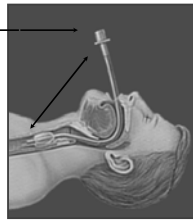
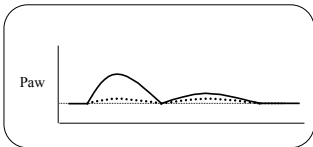


## ET-Tube Compensation - Automatically Adjusts Pressure To "Erase" The ET-Tube

Higher Circuit Pressure

- TC adds appropriate pressure to keep carina pressure at preset PEEP

No decreased Carina Pressure .....

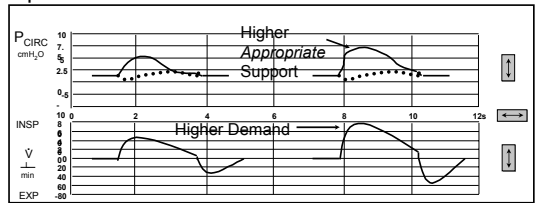
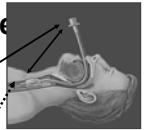


## ET-Tube Compensation - Automatically Adjusts Pressure to "Erase" the ET-tube

Higher Circuit Pressure

- TC adds appropriate pressure to keep carinal pressure at preset PEEP

Baseline Carina Pressure

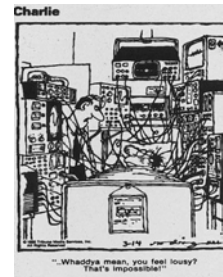


## TC Pressure Variability



## Indications for TC/ATC

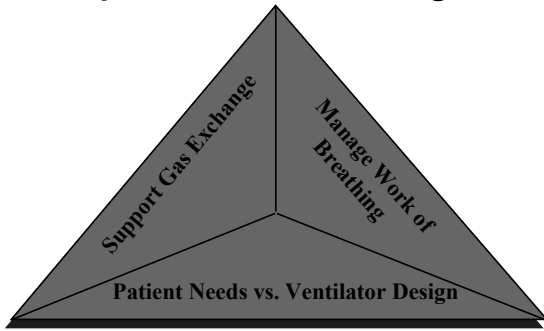
- Patients who have compromised respiratory function
  - COPD, malnutrition, respiratory muscle failure
- Those who have failed previous extubation attempts
- The "difficult to wean" patient



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## Considerations for Spontaneous Breathing?



## Comments and Questions

