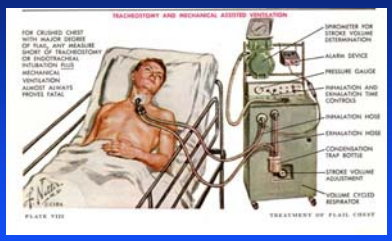
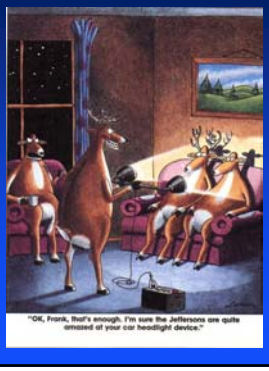
Managing The WOB: How Can You Help?



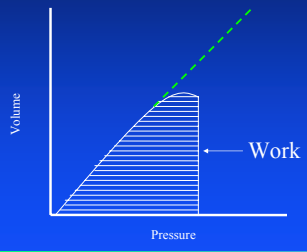
Terry L. Forrette, M.H.S., RRT

Overview of Presentation



- Defining the WOB
- Measuring and Applying WOB Measurements
- Strategies to Manage the WOB

Work: A Basic Feature In All Interactions

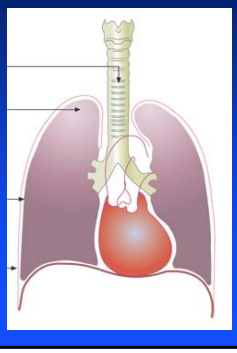


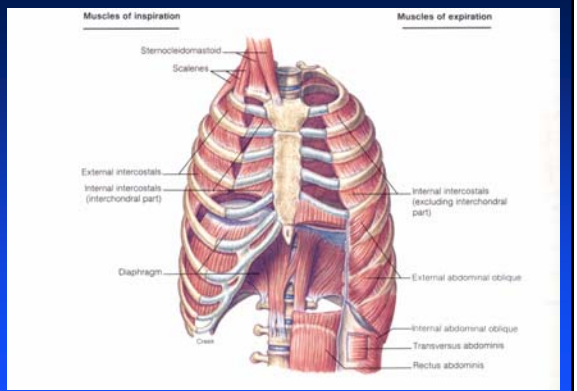
Physiologic Components of Work

Non-elastic work to overcome airway resistance

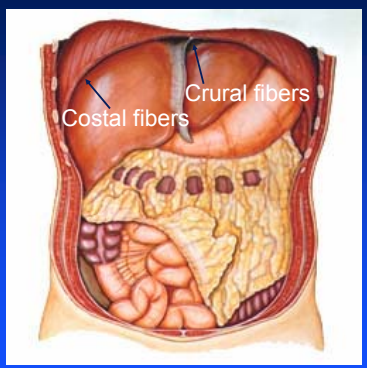
Elastic work to inflate the lungs

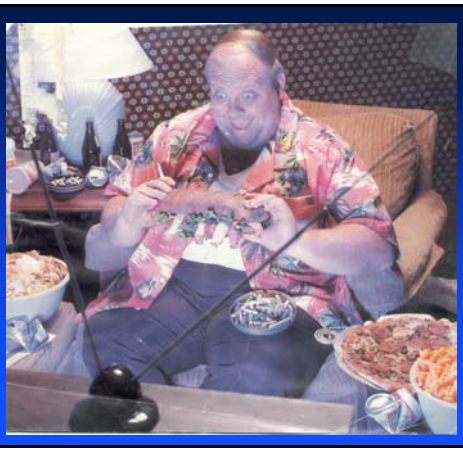
Elastic work to expand the thorax





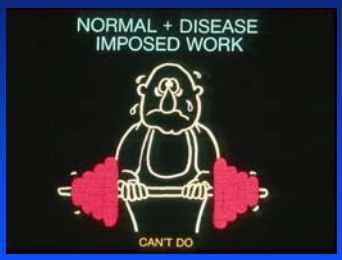
Diaphragmatic Function



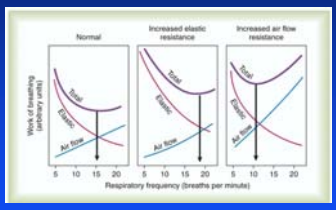


Work of Breathing Components

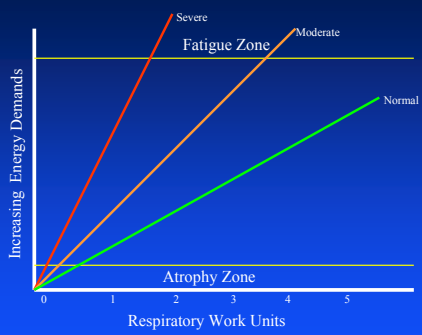
- Patient
  "physiologic"
  - Ventilatory pattern
  - Underlying disease
- Mechanical
  "imposed"
  - Circuit/airway
  - Mode of ventilation



The Influence Of Rate & Tidal Volume On The WOB

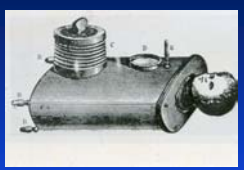


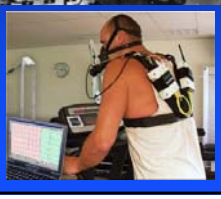
- Restrictive disease favors fast rates with smaller volumes
- COPD patients have less WOB with lower rates and larger volumes



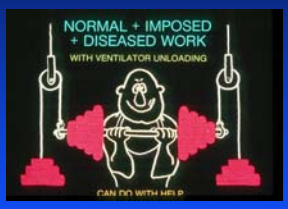
Where is your patient?

Measuring The WOB

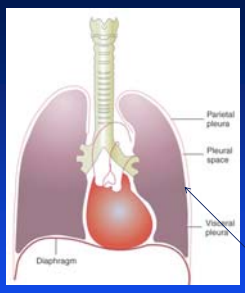




Measuring the WOB

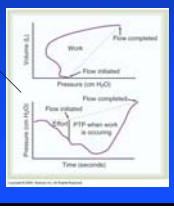


- Calculations
  - Airway/esophageal
  - Oxygen consumption
- Indirect
  - C_{LT}, Raw, VC
  - RSBI, NIF, P_{100}
- Graphics
  - PV and FV loops

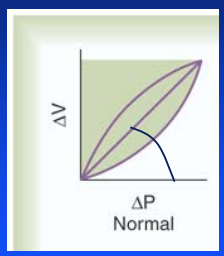


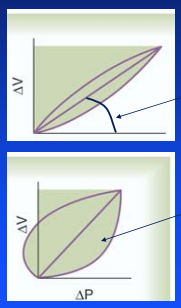
- TTdi – tension time index and indicator of fatigue
- Pdi – trans diaphragmatic to measure work
- Independent measurements of lung and chest wall mechanics

Esophageal Pressure Monitoring

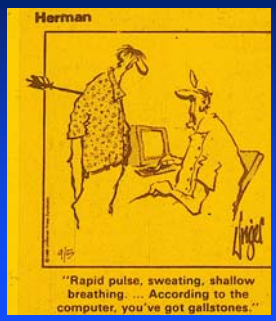


Using Graphics To Display The WOB





Clinical Assessment

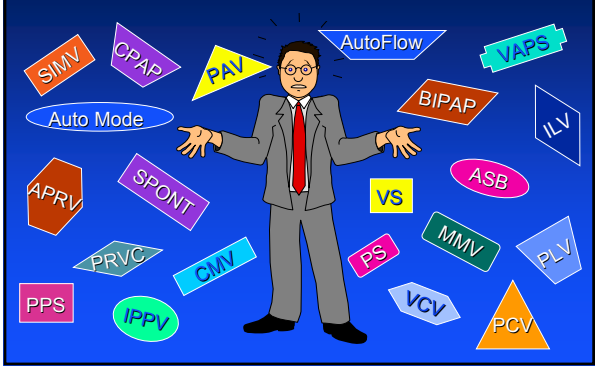


Strength
- NIF >- 20 to 30
- VC- 70- 80 mL/kg/IBW

Endurance
- RR 24- 38 br/min
- V_T 5- 7 mL/kg IBW
- RSBI < 105 br/L
- V_E 200 mL/kg IBW

Patient Comfort

How Can You Help?



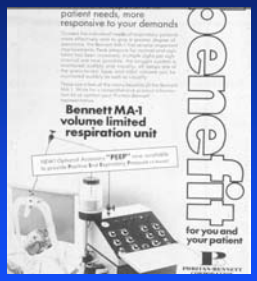
Assisted Ventilation Breath Types

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

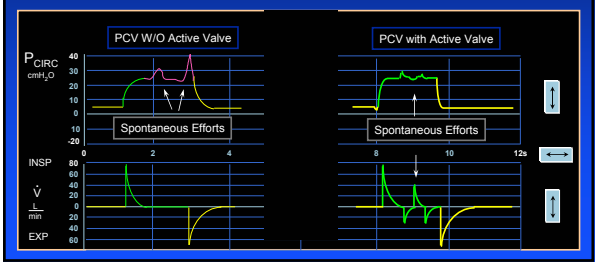
New Generation of Gas Delivery Systems



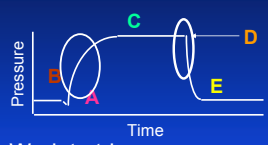
- Active exhalation valves
- Overcoming imposed WOB
- Tailoring breath delivery

Active Exhalation Valve

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

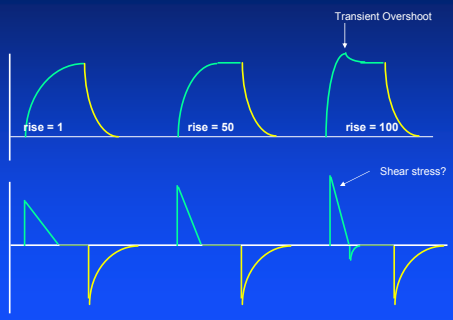


The ABC's of Breath Delivery



A - Work to trigger
B - **Rise time**
C - Preventing pressure overshoot and sustaining the breath
D - **Transition into expiration**
E - Expiratory resistance

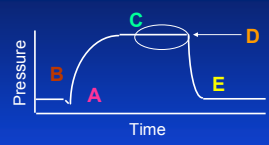
% Rise Time



Setting Rise Time

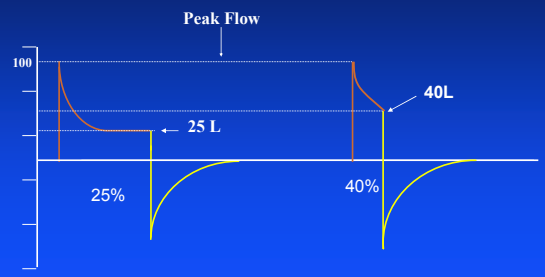
- Monitor volume delivery
- For patients with increased flow demand use higher rise times
- Obstructive patients may be more comfortable with lower rise times
- Use RSBI , graphics, and observe for signs of dysynchrony

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}) %



A method to adjust spontaneous T_I

Selecting Termination Criteria

- Improving patient - ventilator interaction
  - decrease work of breathing
  - increase synchrony
- Adjusting inspiratory time
  - pediatric patients and restrictive conditions – increase T_I
  - obstructive airway disease – decrease
  - use RSBI, graphics and monitor for dysynchrony.

Assisted Spontaneous Ventilation Breath Types

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- BiLevel/APRV

Volume Constant Assisted Ventilation

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

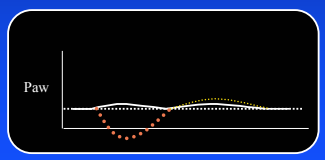
PAV/PPS & TC

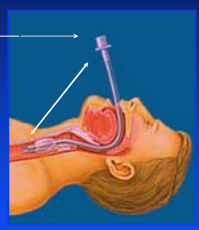
What The Carina Sees...

Circuit Pressure

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

Lower Carina Pressure

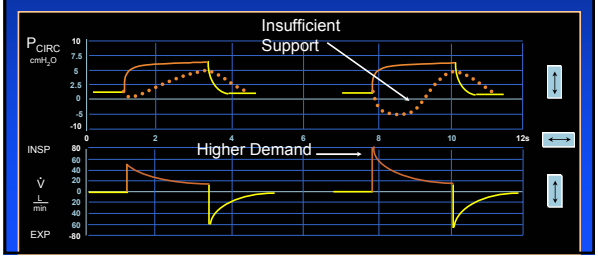




Pressure drop shows imposed work across ET-Tube when flow is present

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 demand is high

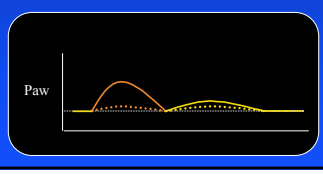


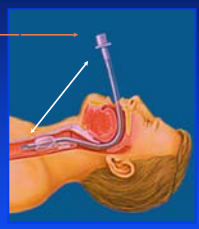
ET-Tube Compensation - Automatically Adjusts Pressure To "Erase" The ET-Tube

Higher Circuit Pressure

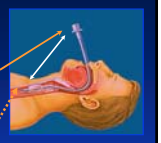
- TC adds appropriate pressure to keep carina pressure at preset PEEP

No decreased Carina Pressure





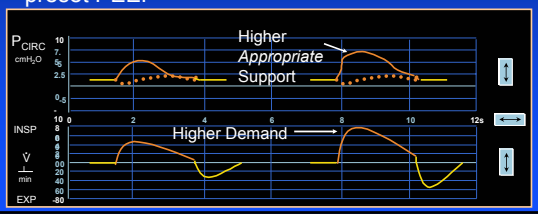
ET-Tube Compensation - Automatically Adjusts Pressure to "Erase" the ET-tube



Higher Circuit Pressure

Baseline Carina Pressure

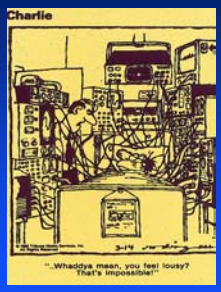
- TC adds appropriate pressure to keep carinal pressure at preset PEEP



TC Pressure Variability

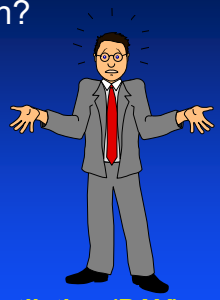
Indications for TC/ATC

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



What If You Need to Augment Ventilation?

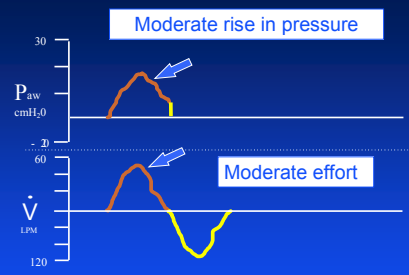
- **TC doesn't address variable work loads, it only "erases" the ET-tube**
- **PS can augment WOB, but at a fixed level**
- **Is there a better way of putting the respiratory center in control of ventilation?**



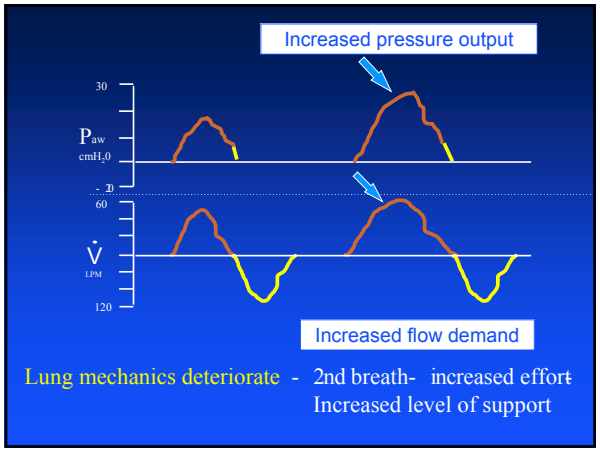
Proportional Assist Ventilation (PAV)
Proportional Pressure Support (PPS)

Proportionately Augmenting Patient Effort

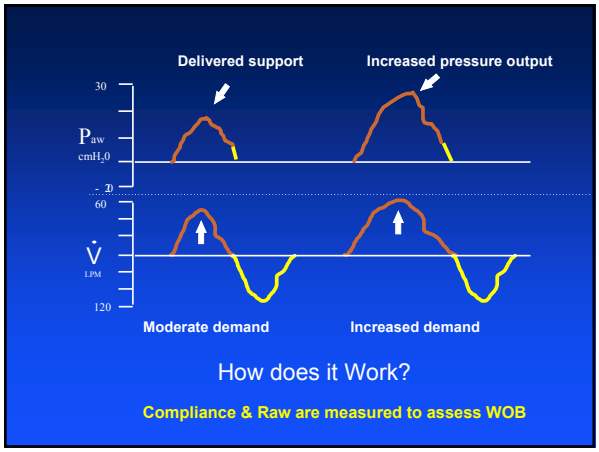
- Neither pressure or volume are preset
- % Work for the ventilator is set
- The patient's respiratory center is in charge of the support level
  - increase drive = increased support pressure
  - decreased drive = decreased support pressure
- Rise time and E_{sens} for synchrony



Imagine we have PAV - 1st breath- moderate effort- Moderate level of support



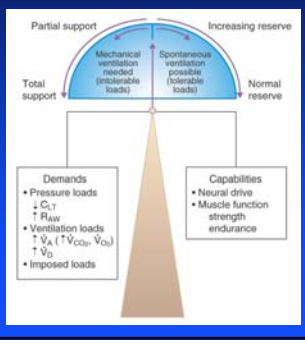
Lung mechanics deteriorate - 2nd breath- increased effort
Increased level of support

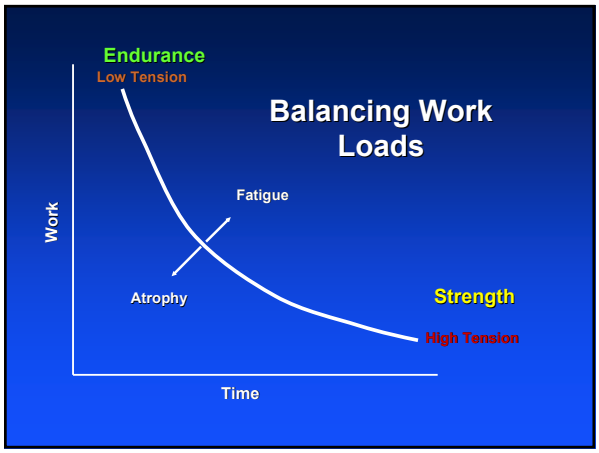


How does it Work?

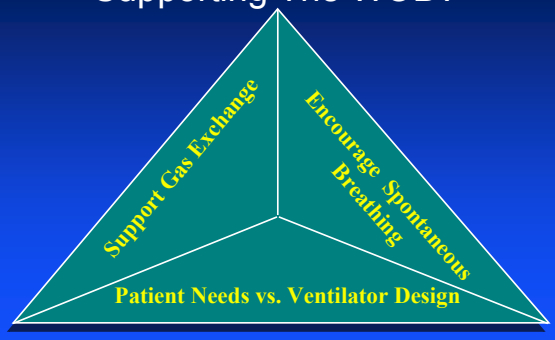
Compliance & Raw are measured to assess WOB

Now It's Time To Let The Patient Do Their Share Of The WOB

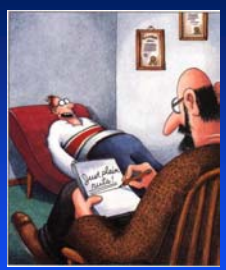




Considerations For Supporting The WOB?



Comments and Questions



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