

Mechanical Ventilation

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For CAPS 422

Introduction

- What is mechanical ventilation?
- When is it used clinically?
- Modes of mechanical ventilation
 - X-Cycled
 - PEEP and CPAP
- What are some complications associated with mechanical ventilation?

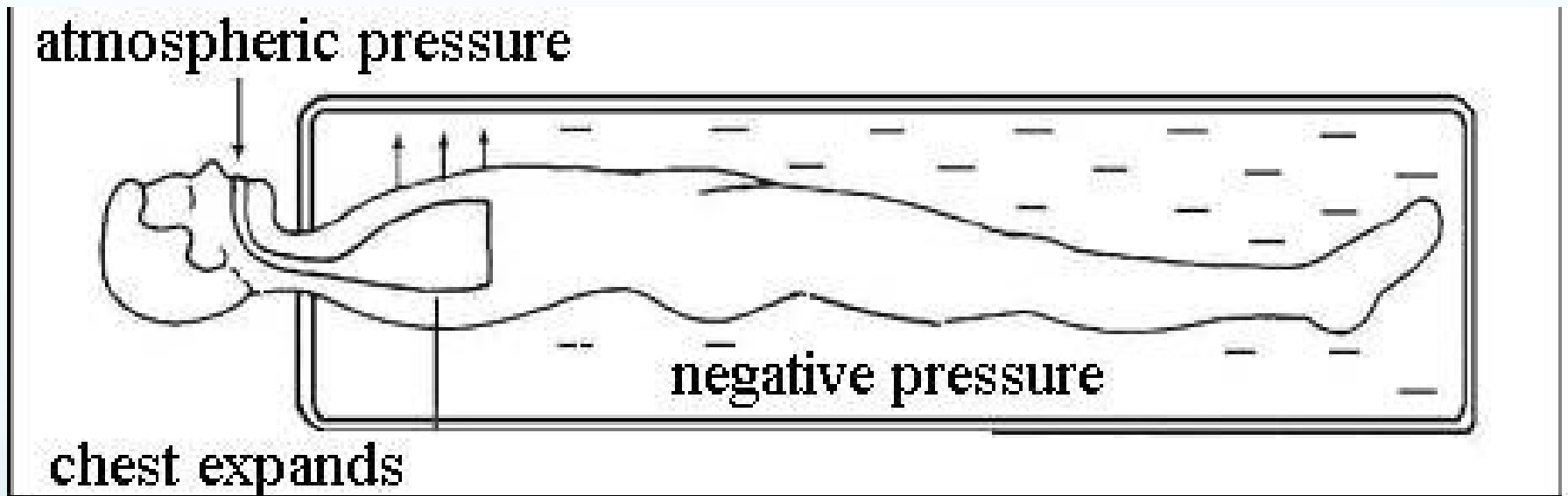


What is mechanical ventilation?

- Essentially, “to breathe for a patient who cannot breathe properly on their own”
 - Method of artificial ventilation used to replace spontaneous breathing
- Two main modes:
 - Negative pressure ventilation
 - Positive pressure ventilation



Negative Pressure Ventilation



History of Negative Pressure Machines

- First negative pressure machine developed in 1929
- Widespread use after polio epidemic
- Vacuum produced inside tank creating negative pressure
- Smaller device, cuirass, creates negative pressure to chest only

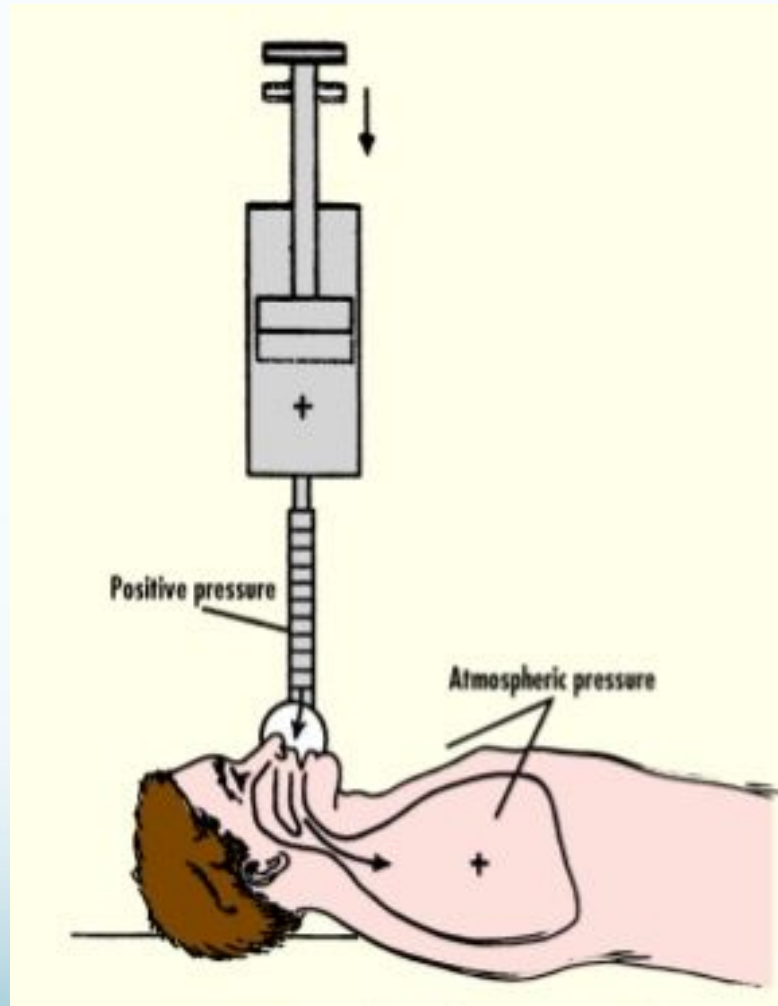


https://www.youtube.com/watch?v=DkwYoDv_e50



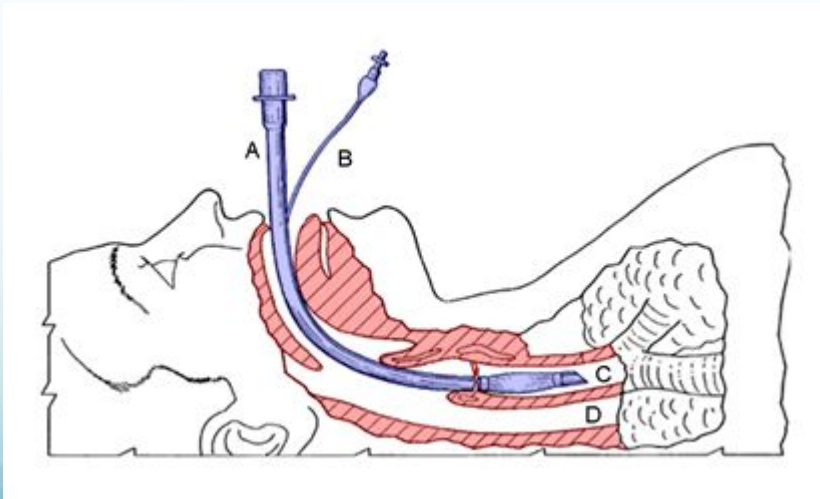
<http://www.hayekmedical.com/about-bcv/>

Positive Pressure Ventilation



History of Positive Pressure Machines

- Replaced iron lungs with safe endotracheal tubes
- Increased pressure in airways “pushes” air into the alveoli
 - airway pressure then drops to 0
 - elastic recoil of the chest wall causes passive exhalation



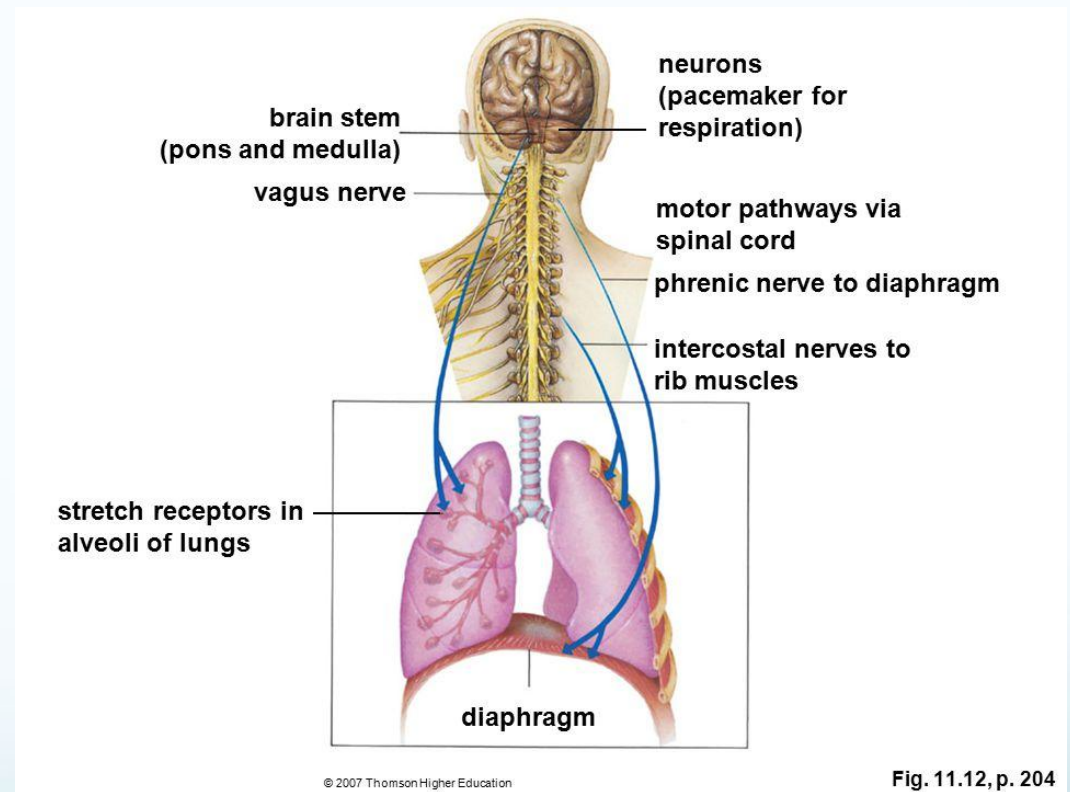
General Symptoms

- Bradypnea
- Sleep apnea
- Hypotension
- Trauma, pneumonia, sepsis
 - Acute lung injury
 - Acute respiratory distress syndrome



General Symptoms

- Neuromuscular disease
- Respiratory muscle fatigue
- Coma/high spinal cord injury



Different modes of mechanical ventilation

- Time cycled
- Flow Cycled
- Volume cycled
- Pressure cycled



- Positive End Expiratory Pressure (PEEP)
- Continuous Positive Airway Pressure (CPAP)

Time-cycled and Flow-cycled

- Time-cycled ventilators deliver oxygenation over a preset time period
- Flow-cycled ventilators deliver air until a preset flow is achieved during inhalation

Volume cycled mechanical ventilation

- Deliver gas at preset volume; allow passive expiration
 - Pressure varies
- Ideal for ARDS or bronchospasm

Advantage: same volume delivered regardless of airway resistance or compliance, minimum WOB

Disadvantage: progressive hyperinflation if volume is too high

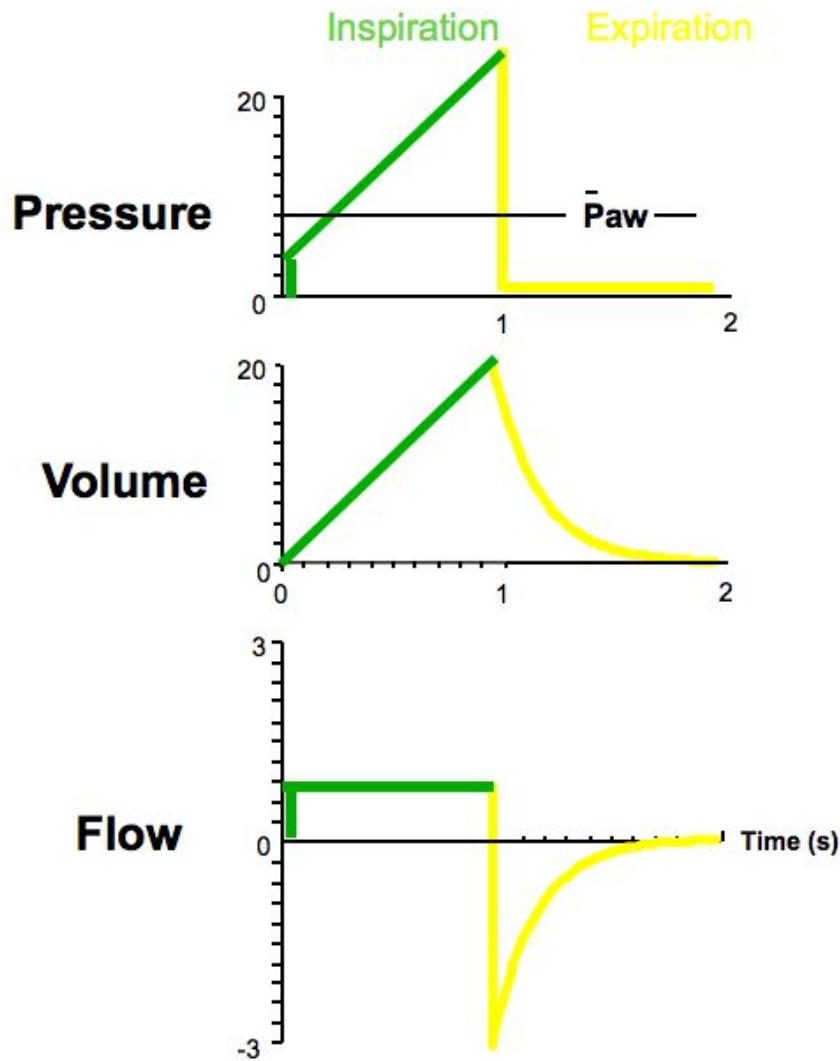
Pressure-Cycled

- Deliver gas at preset pressure; allow passive expiration
 - Tidal volume varies
- Often used for ARDS (acute respiratory distress syndrome)

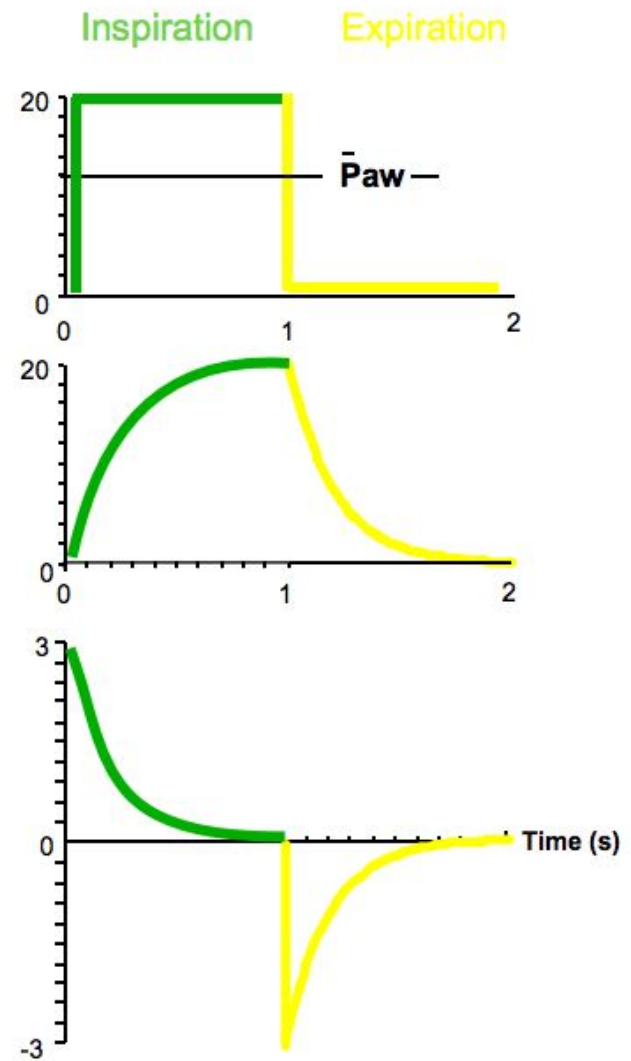
Advantage: decreased risk of lung damage from high inspiratory pressures (barotrauma)

Disadvantage: tidal volume delivered can vary with changes in lung resistance and compliance

Volume/Flow Control

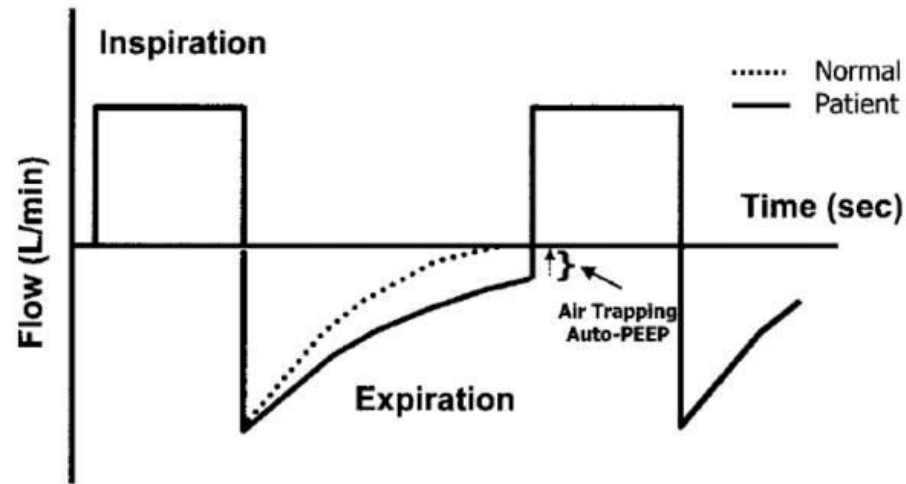


Pressure Control

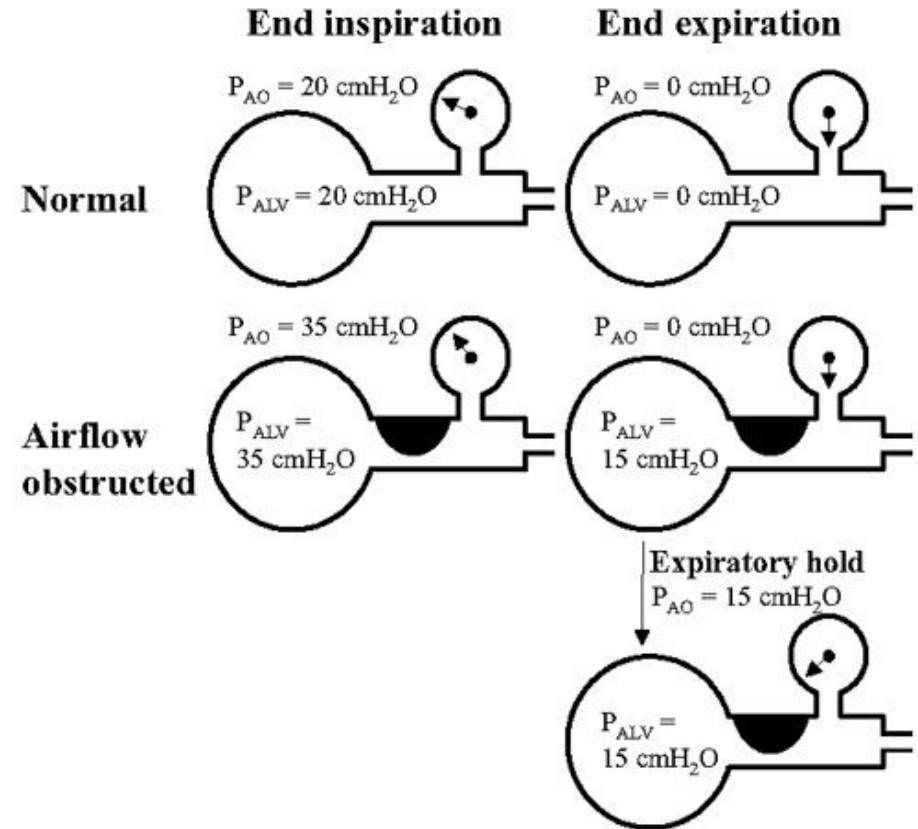


Intrinsic Positive End Expiratory Pressure (PEEP)

Air Trapping



Critical Care



Critical Care

Auto-PEEP and Continuous Positive Airway Pressure Ventilation (CPAP)

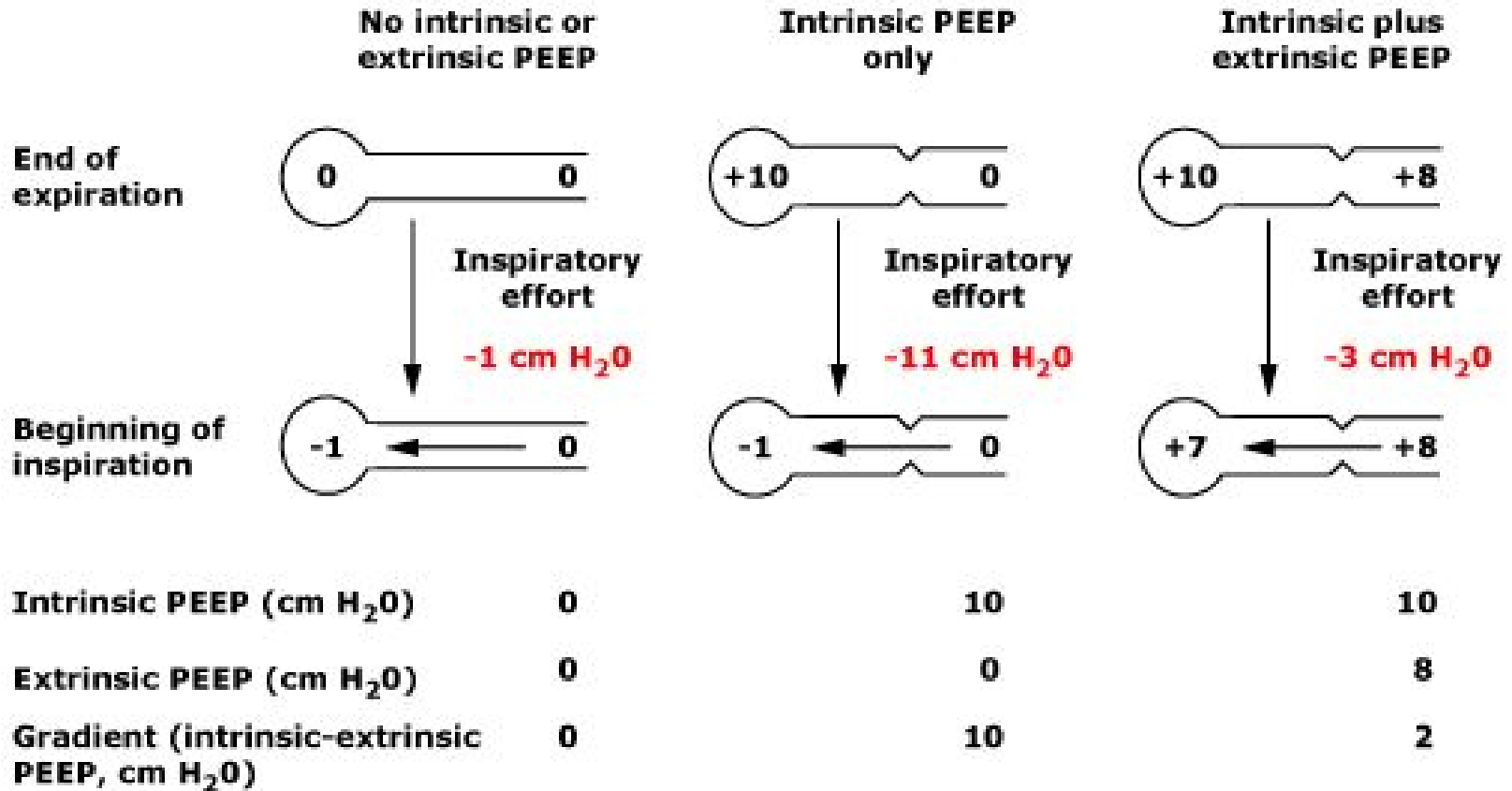
- **Auto-PEEP**

- Airway pressure greater than atmospheric, airways kept open at **end of breath**
- Mitigates end expiratory alveolar collapse
- Risk of decreasing cardiac output

- **CPAP**

- Continuous flow of air at same pressure
- Airway pressure greater than atmospheric throughout breath, **ventilator does not cycle, patient initiates own breath**

Auto-PEEP ameliorates Intrinsic PEEP



PEEP and CPAP Devices

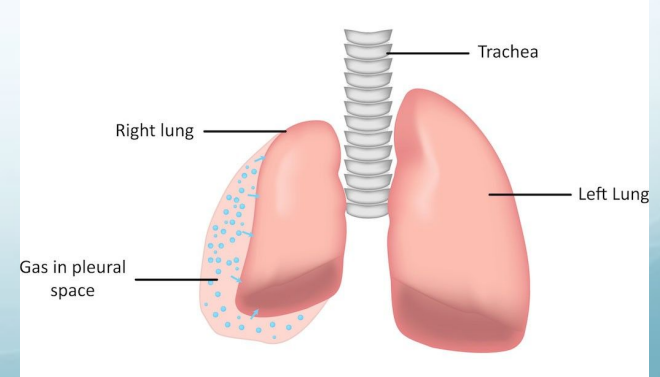
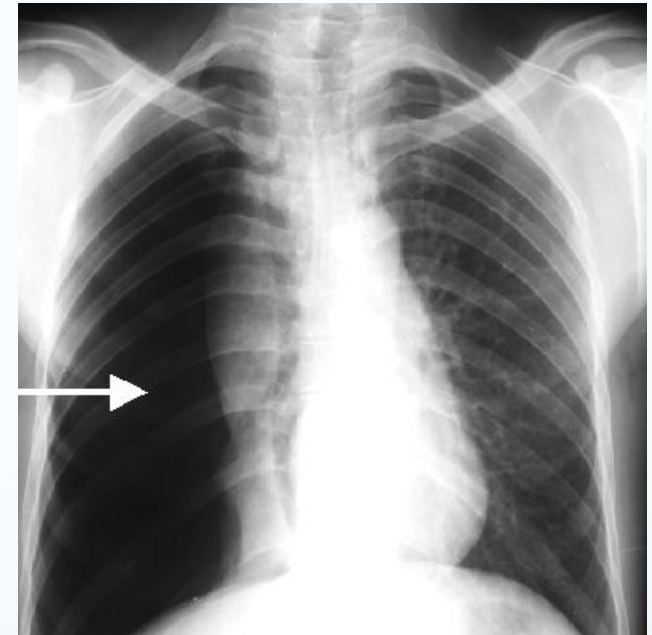


<http://www.fundairing.com/#liberate-sleep-apnea-sufferers-everywhere>

Complications with Mechanical Ventilation

Barotrauma

- Significant change/difference in pressure between different surfaces causing damage to the tissue
- Hyperinflation of alveoli leading to rupture
- Pneumothorax, subcutaneous emphysema,
- eg. Volume cycled ventilation, **forcing** a predetermined volume of air into lungs



Complications with Mechanical Ventilation

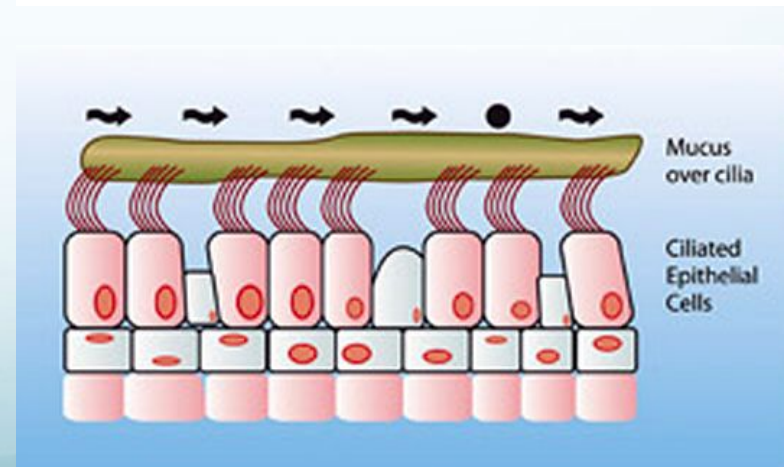
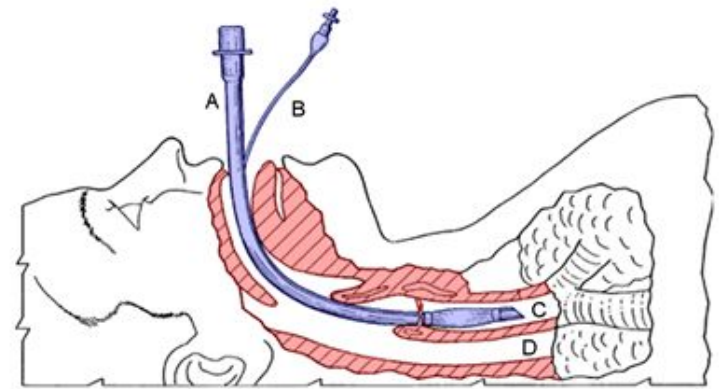
Ventilator associated pneumonia

- especially invasive ventilators

Diaphragm atrophy

Impair mucociliary motility

- retention of secretions
- increase risk of infections



Summary

- Negative and positive pressure ventilators
- Used when patient's own ability to ventilate is compromised, or insufficient
- Multiple modes
 - Time, Flow, Volume, Pressure Cycled
- Positive End Expiratory Pressure (PEEP)
- Continuous Positive Airway Pressure (CPAP)
- Complications
 - Barotrauma
 - Infections
 - Diaphragm atrophy

Thank You!

Questions?

References

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