Vent III Pressure control Ventilator Management

- Medical Practice Improvement Project
- Paul Wisniewski, DO
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Disclosures

- None

Learning Objectives

- 1. Look at pressure control ventilation
- 2. Managing and Calculating tidal volume
- 3. Managing Airway pressures
- 4. Increasing oxygenation and ventilating difficult conditions

When Do We Initiate Pressure Control Ventilation?

- Patients that can not be ventilated or oxygenated using volume cycled ventilation.
  - High Peak Airway pressure
  - Low lung compliance
  - Poor oxygenation requiring higher mean airway pressure to achieve oxygenation
  - Lung Protective strategies

Peak Airway Pressure: Does it Matter?

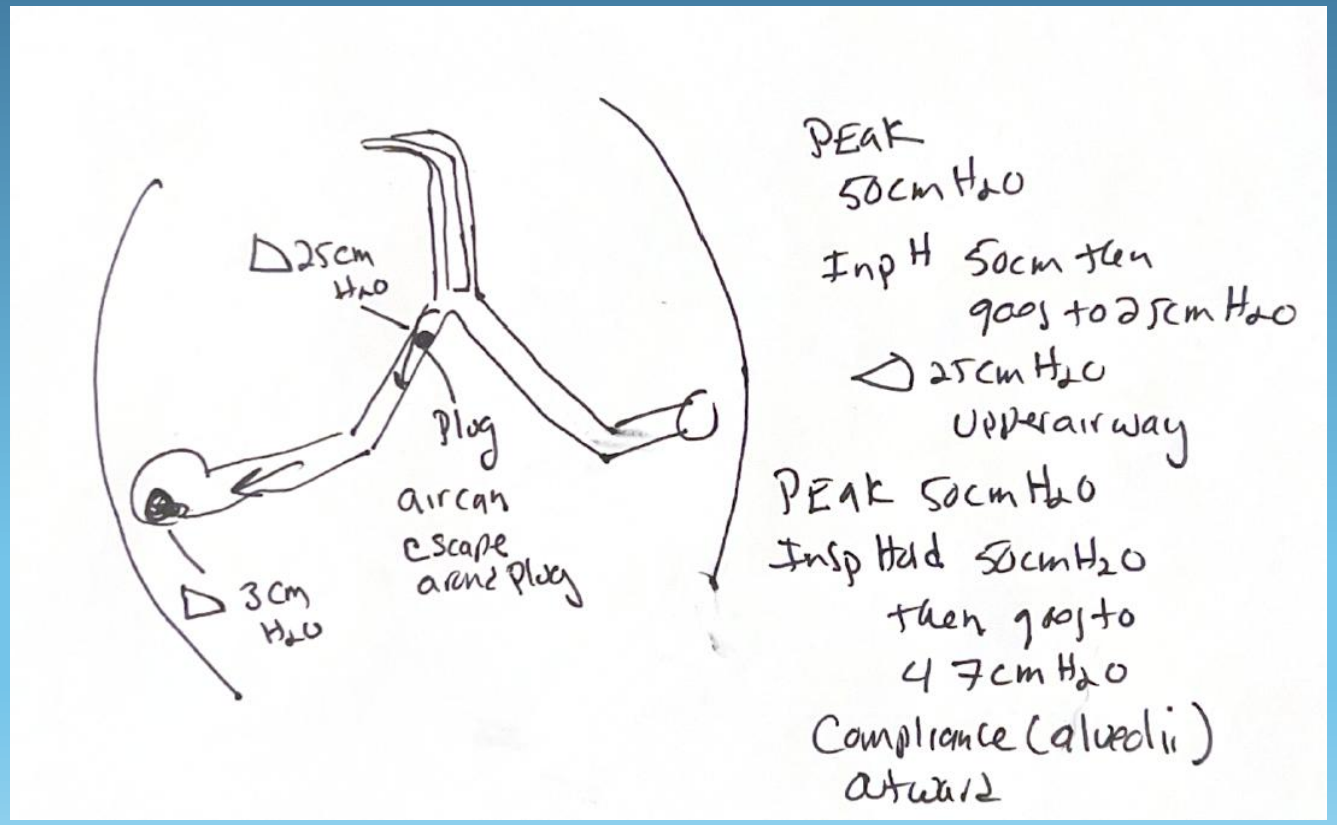
- Short answer: **Not really**
  - What?!
  - The pressure observed at the alveoli is what matters

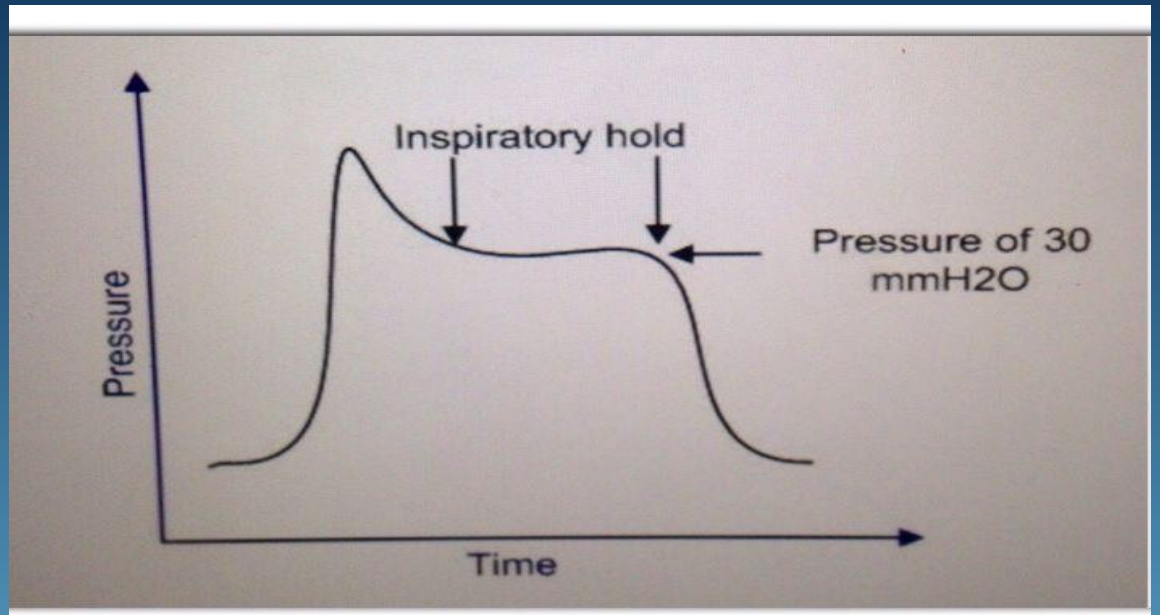
  - What is the Goal for Peak airway pressure?
    - Less than 35 cm H20 everyone agrees is safe
      - **Pressure observed at the alveoli**

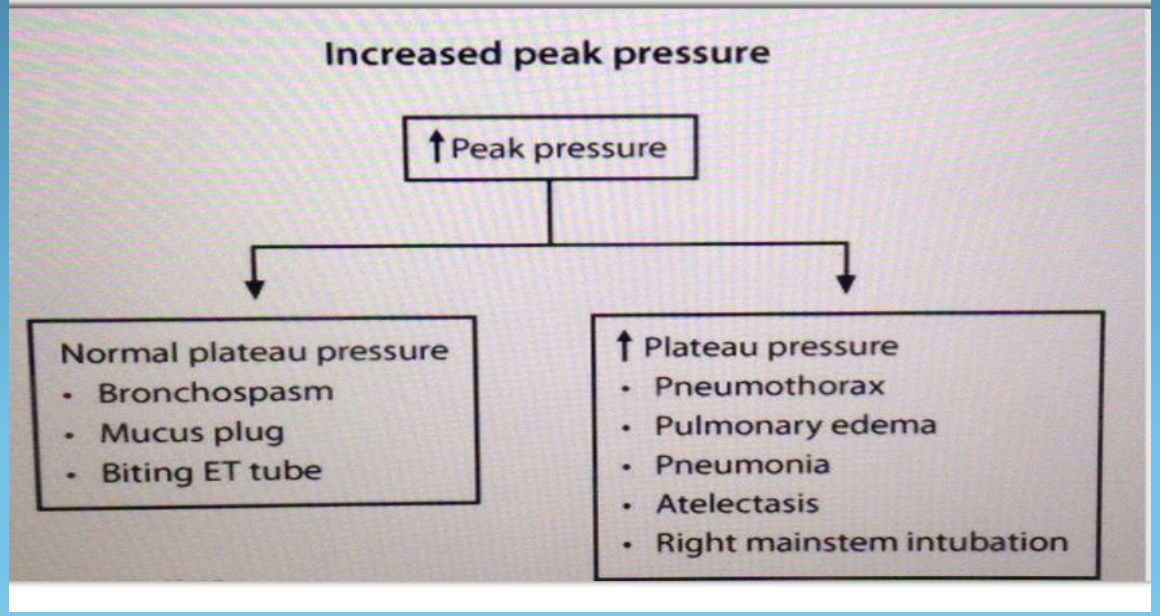
If the high airway pressure alarm rings and is showing high peak pressure: What next?

- Need to do two maneuvers
  - Inspiratory Hold → plateau pressure
  - Expiratory Hold → Autopeep
- Inspiratory Hold:
- Tell you the plateau pressure
- Plateau pressure
  - An inspiratory hold on a ventilator is used to measure the plateau pressure (Pplat), which is the pressure used to maintain the air in the lungs. It reveals the pressure in the alveoli and helps assess lung compliance
  - A change of less than 4 cm of H20 show it is at the alveoli or outward (Compliance problem)

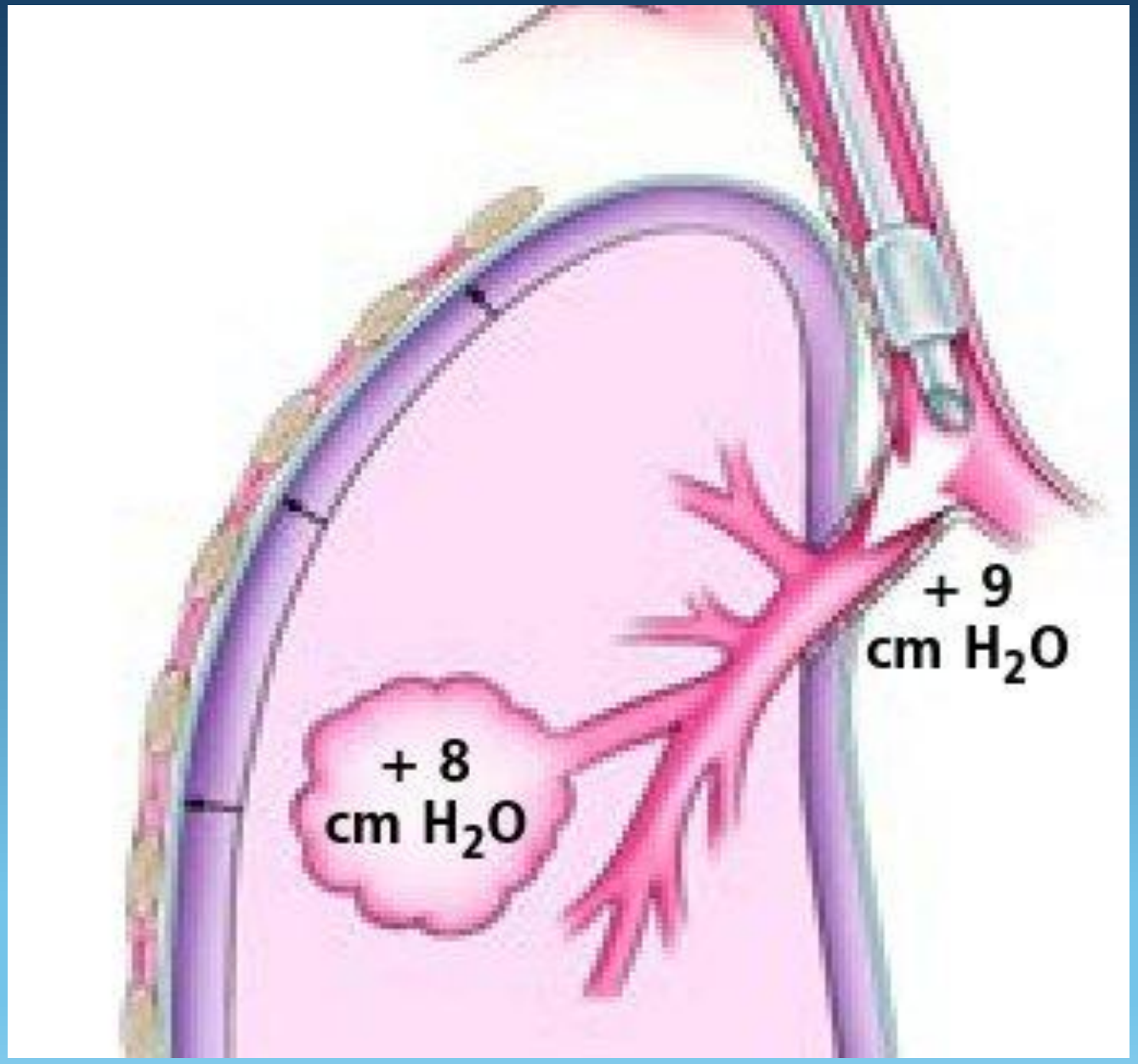
Inspiratory Hold and Its Meaning







Expiratory Hold to Assess AUTO PEEP



So Much Pressure: What Matters?

- Pressure at the alveoli that matters
  - Goal is pressure less than 35cm H20
- There are times in difficult patients I will do inspiratory hold and see that the Pplat is less than 35 cm H2O and let the PEAK Airway pressure be 50 cm H20. What matters is what pressure is the alveoli seeing…….

Now How Do we Set up a PC controlled Ventilator?

- Set the Ventilator
  - Rate : 10-20 breathes per minute
  - FI02 30-100%
  - Peep 5-15 cm H20
  - Inspiratory Pressure (IP) 10-30 cm H20
  - TV→ not set TV → based on compliance of the lung
    - Let's look at some formulas

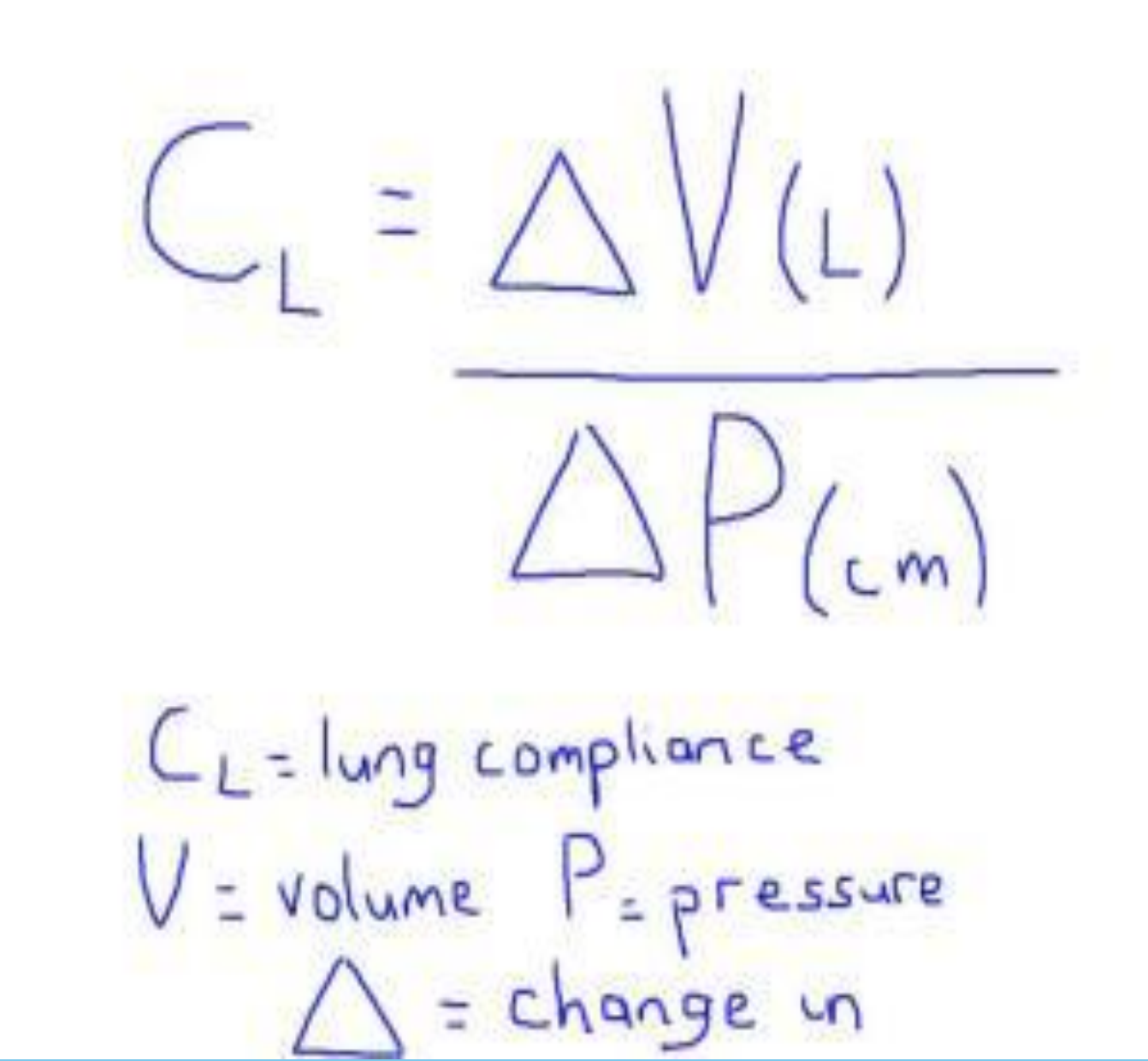
Formulas to Help set the PC vent mode

- Total Airway pressure
  - Goal want less than 35 cm H20
    - can go to 45cm H20 or 50 cm H20 if needed.
  - Total Airway Pressure = Sum of the Pressures in the system
    - TAP= ∑ pressure = IP + PEEP

Compliance and its relationship to pressure and volume

- Lung compliance
- Solve for tidal volume
- TV = C_L *ΔP

- The bigger the ΔP the bigger the tidal volume.
- Small amounts of pressure should get large volumes.
- IF not, then compliance is poor and there is trouble



Tidal Volume

- ΔP = Difference in Pressures
  - ΔP = IP – Peep
  - Increasing IP will increase the delta
  - Increasing peep will decrease the delta
  - Mean airway pressure and peep are necessary to oxygenate
  - If you increase peep 2 cm H20 then you need to increase IP 2 cmH2o to keep the same tidal volume
  - Keep the ΔP the same but you increase the total airway pressure by 4 cm H2O
  - $TV = C_L * \Delta P$

How do I Know that the patient is Recovering?

- Math will tell us

If the tidal volume is increasing with the same pressure the lung is recovering

Compliance is improving

$$TV = C_L * \Delta P$$

What do I do with Increasing Tidal Volume?

- Start to decrease the IP (Inspiratory Pressure) to maintain same tidal volume
- Decrease PEEP as Oxygenation (O2 Saturation and PaO2) determines
  - When the Total Airway pressure is less than 25 cm H2O consider transition to volume cycled ventilation again
    - TIPS when transitioning
    - Keep the PEEP the same
    - Keep the Fio2 the same
    - Need FiO2 less than 50%
    - The patient may desaturate for a few minutes as the MEAN Airway pressure is lower

Mean Airway Pressure Calculation

- Advantages
  - Time average of pressure in cycle
  - Direct relationship to oxygenation
  - Higher in Pressure ventilation
  - Inverting Ration of I:E adds significantly to Mean Airway Pressure
  - PEEP is Biggest component to Mean Airway pressure

Mean Airway Pressure ($\overline{P}aw$)

$$\overline{P}aw = \frac{(T_I \times PIP) + (T_E \times PEEP)}{Ttot}$$

$$\overline{P}aw = (PIP - PEEP) \times T_I/Ttot + PEEP$$

- Pressure ventilation

$$(PIP - PEEP) \cdot (T_I / T_{tot}) + PEEP$$

- Volume ventilation

$$0.5 \cdot (PIP - PEEP) \cdot (T_I / T_{tot}) + PEEP$$

Next Week

Final Lecture in Vent Series

Difficult conditions and Trouble shooting

- Look at strategies for ARDS
- Adjuncts to ventilation (Prostacyclin and NO)
- When do you consider ECMO?

- Next Lecture January 30 , 2025

Works Cited

what does and expiratory hold tell you on the vent - Search Images

what does an inspiratory hold tell you on the vent – Search

simplifed equation for lung compliance - Search Images

simplifed equation for mean airway pressure in pressure control ventilation - Search Images

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