

# Initial Assessment of the Mechanically Ventilated Patient

## Chapter 9

# What do you do first?

- Look at your patient
  - Color
  - RR
  - Breathing pattern
  - Use of accessory muscles
  - Chest movement
  - Easily audible breath sounds
  - Work of breathing
- Check your orders
- Verify that the ventilator has passed the operational verification procedure (OVP)

# Patient-Ventilator Systems Check

- Checks are performed according to hospital policy (usually every 1-4hrs) or before:
  - ABG's
  - New orders or vent changes
  - Hemodynamic or PFT measurements
  - Acute changes in patient condition
  - Questionable ventilator performance
- Evaluation of the ventilators function and the patient's response to ventilatory support
- Documentation contains
  - Data relevant to the patient's condition
  - Patient's information and observations of ventilator settings
  - Physician's orders for settings
  - Brief narrative of the clinical observations
- **PART OF THE MEDICAL RECORD!**

# Clinical Rounds 9-1 p. 153

## Reasons for Documentation

A 38-year-old woman is intubated for respiratory failure secondary to severe pneumonia. After 24 hrs her status improves. The ETT is kept in place to allow suctioning, because she has large amounts of secretions. On the third day after intubation her respiratory status declines. She has a cardiac arrest and is resuscitated but suffers brain injury as a result. She dies several weeks later. The family hires an attorney. At issue is the fact that in the medical record, the respiratory therapist's notes with the ventilator flow sheet indicate that the patient had been suctioned about q2hrs for large amount of thick yellow secretions. However during the 8 hrs before the arrest, nowhere did the notes state that the patient had been suctioned. The therapist states that he had suctioned the patient but had not recorded it in the chart. Was the therapist negligent and did his actions lead to the wrongful death of the patient?

The legal inference is that if treatment is not documented, it is not done. The therapist must prove that he provided care despite a lack of documentation. He argued that he did not want to repeat the same information over and over and that he had "charted by exception". Fearing that a jury might not believe the therapist, the hospital settled the case out of court.

# The first 30 minutes

- Listen to breath sounds
- Check vital signs
- Alarms are activated
- ABG
- CXR for tube placement
- Laboratory tests
- First ventilator check
  - Mode
  - Sensitivity
  - Tidal volume, rate, and minute ventilation (correct for tubing compliance)
  - Pressures

# Alveolar Ventilation

- Dead Space: normal anatomical dead space is 1ml/kg IBW
- Added mechanical dead space: volume of anything added into the circuit between the Y-connector and the ETT – HME's, flex tubing, MDI adaptors
- $V_A = (V_t - V_{d \text{ mech}} - V_{d \text{ anat}})f$

# Monitoring Airway Pressure

- PIP: peak inspiratory pressure, the highest pressure observed during inspiration
  - Increasing PIP can indicate a decrease in lung compliance or an increase in airway resistance
  - Decreasing PIP may indicate a leak or a sign of compliance or resistance improvement
  - Used to calculate dynamic compliance
- $P_{plat}$ : Plateau Pressure,
  - Obtained by using an inspiratory pause, read the static pressure when no gas flow is occurring
  - Should be kept  $<30\text{cmH}_2\text{O}$
  - Cannot be accurately measured if the patient makes active respiratory efforts
  - Used to calculate static compliance
- $P_{TA}$ : Transairway Pressure, the amount of pressure needed to overcome airway resistance
  - Difference between the PIP and  $P_{plat}$
  - Increases when the patient needs suctioning or is biting on the ETT, tube is kinked, HME is occluded with secretions, the patient has mucosal edema, or bronchospasms
- EEP: end expiratory pressure includes CPAP, PEEP, and auto-PEEP
  - Measure auto-PEEP with an expiratory pause
- Paw: mean airway pressure
  - closely parallels the mean alveolar pressure
  - important for oxygenation and affects lung volumes and cardiac output

## Pressure Limit

- Usually set 10 cmH<sub>2</sub>O above PIP
- Activation ends inspiration
- Some vents have an alarm delay but the breath still ends
- Activated by coughing, increase in airway resistance, decrease in compliance

## Low pressure alarm

- Usually set 5-10 below PIP
- Indicates a leak

# Evaluating for Leaks

- Every ventilator check must include assessing the circuit integrity
- PIP and Vt measurements are lower than previous measurements
- Start at the patient connection and work back to the ventilator – may need to disconnect the patient and provide manual ventilation while testing the circuit

- Alarms are only activated by critical changes, moderate changes in vital signs during hourly or bihourly checks should alert the practitioner to any changes in status
- Observe and record the patient's blood pressure, heart rate, temperature, respiratory rate, pulse oximetry, and color

# Clinical Rounds 9-2 p. 161

The cardiac monitor on a mechanically ventilated patient suddenly activates. The patient demonstrates sinus tachycardia. The nurse and RT check the patient but do not immediately find the cause of the tachycardia. The nurse lowers the covers from around the patient's upper chest and discovers that the patient is disconnected from the ventilator. What probably prevented the ventilator's low pressure alarm from activating?

The low pressure alarm did not activate for several reasons.

- may have been set too low
- bedding may have been covering the Y-connector

The low pressure alarm must be set appropriately also setting the low volume alarm would have alerted the RT prior to the tachycardia

# Management of the tube

- The ETT must be repositioned and re-secured at least once a shift to prevent tissue breakdown
- Mouth care needs to be performed routinely
- Cuff pressure needs to be assessed once a shift
  - Should not exceed 20-25cmH<sub>2</sub>O to reduce the risk of tracheal damage
  - Measured with a manometer
  - Sometimes a higher pressure is needed to seal (ETT is high or too small, anatomical differences)
- Cuff leaks
  - Check for proper inflation, determine the location of the leak, assess the integrity of the pilot line

# Clinical Rounds 9-3 p. 162

MLT has been used to establish cuff inflation with a cuff pressure of 20mmHg. At this same time (1300) the RT records PIP 28cmH<sub>2</sub>O, set Vt 520ml, exhaled Vt 500ml. At 2100 PIP is 23cmH<sub>2</sub>O, exhaled Vt 520. What might account for an increase in volume while the pressure is decreasing?

The MLT was used to set the cuff pressure so that a small leak existed at 1300. This can be noted by the difference between the set volume and the measured exhaled volume (20ml). Several hours later, the set volume is the same, because no volume change is mentioned. The patient's condition may have improved such that less pressure is required to deliver the same volume. With a lower ventilating pressure, a leak no longer exits around the cuff. Note that the cuff pressure (20mmHg) is equal to about 27cmH<sub>2</sub>O. This is enough intracuff pressure to prevent a leak when the ventilating pressure is only 23cmH<sub>2</sub>O.

# Clinical Rounds 9-4 p. 164

1. A chest physical examination on a pt on mechanical ventilation reveals bilateral rhonchi and normal resonance to percussion. The patient has a temperature of 39°C, HR 122, BP 135/85. What might be the problem? What procedure may be needed?

Finding suggest that the patient has a respiratory infection. A chest radiograph and lab studies could confirm this diagnosis. The rhonchi indicate secretions in the large airways. This patient may need to be suctioned (may want to send sample for C&S for antibiotics)

# Clinical Rounds 9-4 p. 164

2. On chest auscultation, the RT hears no breath sounds on the left but distant breath sounds on the right. The percussion note on the left is hyperresonant, and the note on the right has normal resonance. The trachea is deviated to the right. In the past hour cardiac output has dropped from 6L/min to 4.5L/min. What is the most likely problem?

Pneumothorax on the left side

# Clinical Rounds 9-4 p. 164

3. A female patient has been intubated for 4hrs and is receiving 100% O<sub>2</sub>. Auscultation of the patient's chest reveals normal breath sounds on the right but no breath sounds on the left. The percussion note is normal in the right and dull on the left. The oral ETT indicates 26cm at the teeth. What is the most likely problem?

Right mainstem intubation

# Static Compliance

- Normal Cs = 70-100ml/cmH<sub>2</sub>O (40-60ml/cmH<sub>2</sub>O when ventilated)
- Cs < 25ml/cmH<sub>2</sub>O indicates high WOB
- $Cs = V_t / (P_{plat} - EEP)$
- Changes are a result of a change in the patient's alveolar elastic recoil
- Decreased Cs may be caused by
  - Air trapping
  - Pulmonary edema
  - Atelectasis
  - Consolidation
  - Pneumonia
  - Pneumothorax, hemothorax
  - Pleural effusion
  - Flail chest
  - Pneumomediastinum
  - Abdominal distention
- Decreased Cs implies that ventilation is less effective

# Dynamic Compliance

- Normal 30-40ml/cmH<sub>2</sub>O
- $C_d = V_t / (PIP - EEP)$
- Measured during airflow so it is influenced by lung and chest wall elastic recoil and airway resistance
- $C_d$  decreases when  $C_s$  decreases or airway resistance increases

# Airway Resistance

- Normal 0.6-2.4 cmH<sub>2</sub>O//s
- Estimated by  $P_{ta} = PIP - P_{plat}$  and the inspiratory flow and a constant waveform
- Treatment for increase  $R_{aw}$  is directed at correcting what the cause is – suctioning the airway, clearing an obstruction, or giving a bronchodilator

# Clinical Rounds 9-5 p. 170

**Clinical Rounds 9-5**  
Evaluating  $C_s$  and Raw During Ventilation

**Problem 1**  
While checking the ventilation parameters during W, you notice the following changes in PIP and  $P_{plateau}$ :

Time	Volume (L)	PIP (cm H <sub>2</sub> O)	$P_{plateau}$ (cm H <sub>2</sub> O)
1:00	0.7	23	15
3:00	0.7	28	16
5:00	0.7	35	17

What is the likely cause of the problem? How would you assess the patient to determine the appropriate treatment?

**Problem 2**  
During PV, the following changes are noted:

Time	Volume (L)	Set pressure (cm H <sub>2</sub> O)
1:00	0.65	20
3:00	0.60	20
5:00	0.55	20

What is the likely cause of the problem? How would you assess the patient to determine treatment?  
(See Appendix A for the answers.)

1. The increase in PIP and Pta while Pplat remains constant indicates a change in Raw. Listen to the breath sounds and try to determine the cause of the change.
2. The decrease in Vt indicates a change in lung characteristics. Listen to the breath sounds and try to determine whether the tube has become progressively occluded or is obstructed in some way. Crackles or changes in the percussion note may indicate a change in lung parenchyma that might reduce compliance or a completely obstructed airway that is causing the distal portion of the lungs to collapse. Determine the cause and correct it, increase the set pressure to maintain ventilation if necessary

# Comment Section

- Patient assessment
- Changes in ventilator settings
- Changes in physician's orders
- Description of any equipment problems
- SOAP notes