Troubleshooting and Problem Solving

Chapter 18
Troubleshooting vs Problem Solving

- Problem solving: determining a solution to a problematic situation
  - Need to have the ability to define a problem and correct it in a timely fashion

- Troubleshooting: identification and resolution of technical malfunctions in the patient-ventilator system
  - Involves purposeful resolution of inappropriate and potentially dangerous situations
Protecting the Patient

1. Ensure adequate ventilation and oxygenation
2. Visually assess the patient
3. Auscultation of the chest
4. Assess the monitors, SpO2, HR, etc

✓ Disconnect the patient from the ventilator, manually ventilate
✓ When the patient is safe, review the cause of the alarm
Identifying the Patient in Distress

• Asking yes/no questions
• Observing the physical signs of respiratory distress
• Evaluation of ventilator settings and graphics
Patient Related Problems

- Airway Problems
- Pneumothorax
- Bronchospasm
- Secretions
- Pulmonary Edema
- Dynamic Hyperinflation
- Abnormalities in Respiratory Drive
- Change in Body Position
- Drug induced distress
- Pulmonary embolism
While performing a vent check the RT notes that the patient suddenly develops signs of severe distress. The low oxygen saturation alarm on the pulse oximeter activates. Breath sounds are equal bilaterally with no change from previous findings. The RT disconnects the patient and performs manual ventilation using 100% O2. A suction catheter passes without difficulty. The patient’s distress continues, however and oxygen saturation remains low. The RT notes that the capnographic reading, PetCO2 has changed from its previous value of 35 to 27. An ABG shows no change in PaCO2 but the PaO2 is down 20mmHg and the Pa-etCO2 has increased from 6 to 14mmHg. What is the problem?

The patency of the airway rules out upper airway obstruction, and the breath sounds rule out any sudden change in the patient’s lung condition (secretions, or pneumothorax). The sudden oxygen desaturation with a drop in end-tidal CO2 suggests the possibility of a PE. This cannot be confirmed easily. Ventilator management will not change this problem, it requires immediate medical intervention.
Ventilator Related Problems

• Leaks
• Inadequate oxygenation
• Inadequate ventilatory support
• Trigger sensitivity
• Inadequate flow setting
• Auto-PEEP
• Increased ventilatory drive
Pressure–time

Flow–time

Volume–time

(From Nilsetuen JO, Hargett KD: Respir Care 50:202, 2005.)
Ventilator Dyssynchrony

- Trigger
- Flow
- Cycle
- Mode
- PEEP
- Closed loop ventilation
Alarm Situations

- Low Pressure
- High Pressure
- Low PEEP/CPAP alarms
- Apnea
- Low Gas source pressure or Power
- Ventilator Inoperative/Technical Error
- Operator settings incompatible with Machine parameters
- I:E ratio indicator
Graphics

Used to identify:
• Leaks
• Inadequate flow
• Inadequate sensitivity
• Overinflation
• Intrinsic PEEP
• Inadequate Ti during PCV
• Waveform ringing
The RT hears a low pressure alarm on a patient receiving ventilatory support. She evaluates the patient and finds that the individual is not in distress and is being ventilated and oxygenated. She checks the activated alarm (low Ve), silences it and saves the graphics display. What do these waveforms indicate?
Expiratory Volumes

**Pressure - Volume**

- Volume
- Volume of leak

**Flow - Volume**

- Flow
- Inspiration
- Volume
- Expiration
- Volume of leak
During ventilation of a patient with VC-CMV and 10cmH2O PEEP, the RT notices that the volume time graphic displays an abnormal pattern. During exhalation the RT feels an uninterrupted flow of a small amount of air from the exhalation valve, even though the patient has had no previous evidence of air trapping. What is the problem?

The exhalation valve is malfunctioning and needs to be changed.
Ventilator Responses

• Unseated or Obstructed Expiratory Valve
• Excessive CPAP/PEEP
• Nebulizer function
• High Vt delivery
• Altered Alarm function
• Electromagnetic interference
A patient on a mechanical ventilator receives a bronchodilator. What was the patient’s response to the treatment?

The patient improved after the treatment.
While monitoring a patient on a ventilator, the RT notes that the inspiratory volume is 550ml and the expiratory volume is 375ml. Having established that a very large leak is present, the RT checks the ET cuff and the vent circuit and cannot find a leak. What is another possible source of the leak? if a chest tube is present a leak may exist in the chest drainage system.
A patient on PCV has a set pressure of 12cmH2O, Raw is 12cmH2O, and static lung compliance is 30cmH2O. The patient is actively inspiring and appears to be air hungry. What is the likely problem? What is the maximum gas flow available to this patient?

Insufficient inspiratory gas flow; the pressure setting seems inadequate considering the Raw and Cstat.

Raw = Pta/flow or in PCV using Pset instead of Pta

The pressure needs to be increased to increase the available flow.
A patient on PCV has a set pressure of 30cmH2O, f=12, and Ti=0.7sec. Vt delivery is 0.5L and the patient has respiratory acidosis. The RT wants to increase the Vt. In this situation what is the best way to accomplish this?

This graphic shows that Ti is short and flow is not returning to zero during inspiration. Increasing the Ti provides more time for Pset to reach the alveolar level and increase Vt delivery.
This patient is using accessory muscles to breathe during inspiration. What do you think is the problem?

The machine is not sensitive enough for the patient’s efforts.
An RT increases the mandatory rate to compensate for a respiratory acidosis in a patient with COPD on SIMV. After the change PIP increases from 38 to 45cmH2O, Pplat increases from 27 to 35cmH2O. The patient appears to be in distress. BP has dropped from 135/95 to 125/85mmHg. What do you think is the problem and what is at least one solution?

The patient has developed auto-PEEP since the setting change. A possible solution is to increase inspiratory gas flow to shorten Ti and increase Te.
PEEP therapy needs to be adjusted for a patient with severe hypoxemia. What would be a reasonable PEEP level to set for this patient, assuming all other parameters are stable?

At the very least the PEEP needs to be set above the Pflex point. It would be better to use a recruitment maneuver and use the deflection point after the maneuver.