

Ventilator Complications and Troubleshooting for Hospitalists

Complications to Look Out for on Vented Patients

Barotrauma

- Consequences include ptx, sq emphysema, pneumomediastinum, pneumoperitoneum
- Limit plateau pressure to ≤ 30 cm H₂O
- Keep TV low
- Treat autoPEEP

Ventilator-associated lung injury (VALI)

- Indistinguishable from ARDS
- Secondary to:
 - Alveolar overdistention (volutrauma)
 - Atelectrauma
 - Due to cyclic alveolar expansion (during inspiration) and collapse (during expiration)
 - The collapsing stretches adjacent alveoli and airways creating shear forces causing injury
 - Biotrauma (inflammation)
 - Ventilator-induced release of inflammatory mediators such as TNF-alpha and IL-6 among others. These are already elevated in ARDS so VALI can worsen their condition.
- Treatment is the same as for ARDS using a lung protective strategy with low TVs, higher PEEP

Auto-PEEP (also called intrinsic PEEP, breath stacking, dynamic hyperinflation)

- Due to incomplete exhalation (inspiration initiated before expiratory airflow from the preceding breath has ceased)
- Look at flow volume loop and make sure flow is returning to zero before the next breath.
- Consequences: leads to hyperinflation which increased intrathoracic pressure resulting in decreased CO and BP which can progress to cardiac arrest. Treatment - disconnect pt from ventilator to allow all air to get out.
- Seen in :
 - Obstructive airway disease
 - High minute volume
 - Prolonged inspiratory time (sometimes used to improve oxygenation in refractory hypoxemia)
 - Airflow resistance (bronchospasm, narrow ETT or ventilator tubing)

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- In COPD
 - Make sure on good bronchodilators
 - Increase inspiratory flow rate to allow longer time for exhalation

Hypotension

- Positive pressure from ventilation results in:
 - Decreased venous return (due to increased intrathoracic pressure)
 - Reduced RV output (due to positive pressure in the pulmonary vascular bed)
 - Reduced LV output (due to increased pulmonary vascular resistance causing shift of the interventricular septum to the left impairing diastolic filling of LV)
 - All three of the above will cause decreased blood pressure

Troubleshooting Problems on the Vent

Nurse contacts you as the patient is in increased distress.

Hemodynamically unstable

1. Disconnect from vent and manually ventilate with bag valve mask (BVM)
 - If there is a large exhalation with immediate improvement in stability
 - Auto-PEEP likely the cause.
 - If improves with BVM
 - Evaluate ventilator for equipment failure
 - Consider patient-ventilator asynchrony due to inadequate sedation
 - If doesn't improve, assess difficulty of ventilation with BVM
 - If it is overly easy
 - Assess for dislodgement or air leak
 - If it is overly difficult
 - Pass a suction catheter through the tube to assess for ETT obstruction or kinking
2. If the above measures fail, assess for ptx
 - Auscultation
 - CXR
 - Bedside US

Hemodynamically stable (there is time for a step-wise approach)

1. Check ETT:
 - Migration
 - Air leak
 - Kinking

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2. Exam:
 - Equal breath sounds
 - Chest rise
 - Increased hypoxia
3. Check ABG
4. Check ventilator
 - Evaluate for patient asynchrony
 - Evaluate waveform for auto-PEEP
5. Measure pressures
 - High peak pressure
 - Indicates increased airway resistance
 - Bronchospasm
 - Secretions
 - Mucus
 - Blood
 - ETT obstruction (kinking, pt biting tube)
 - High plateau pressure
 - Indicates decreased compliance
 - Intra-thoracic
 - PTX
 - Pneumonia
 - ARDS
 - Atelectasis
 - Auto-PEEP
 - Pulmonary edema
 - R mainstem intubation
 - Extra-thoracic
 - Abdominal compartment syndrome
 - Ascites
 - Large body habitus
 - Positioning
 - Low peak pressure
 - Cuff leak
 - ETT dislodgement
 - Ventilator malfunction
 - Vent circuit is disconnected
6. Check CXR
 - Eval for worsening pulmonary process
 - PTX (can also be assessed by POCUS)
 - ETT tube position
7. Evaluate adequacy of sedation and analgesics