ANW Hospitalist Ventilator Overview

NIPPV

Trial of NIPPV reasonable in:
- BiPAP in COPD or asthma exacerbations with hypercapnic acidosis
- CPAP in cardiogenic pulmonary edema or acute hypoxemic respiratory failure

Reassess within 30 min to 2 hours after starting NIPPV

Intubate if:
- pH and pCO2 have not improved
- Respiratory distress has not improved
- Worsened encephalopathy
- Inability to clear secretions
- Inability to tolerate any of the interfaces
- Hemodynamic instability
- Decreased oxygenation

Avoid NIPPV in:
- Cardiac or respiratory arrest
- Inability to cooperate, protect airway, or clear secretions
- Severely impaired consciousness (except from hypercapnia)
- Nonrespiratory organ failure which is acutely life threatening
- High aspiration risk
- Prolonged duration of mechanical ventilation anticipated

Intubation

Anesthesia to intubate for us.

Things to watch out for during intubation:
- This is an aerosolizing procedure so airborne precautions in COVID-19 or PUI
- Watch for post-intubation hypotension
    - After intubation, positive pressure ventilation results in increased intrathoracic pressure and decreased venous return. This can decrease BP so if marginal BP at time of intubation, be prepared to use pressors (or fluids if no ARDS or CHF)

To determine vent settings:

What is the cause of respiratory failure? (important in determining settings)

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Initial Vent Settings

- Hypoxic respiratory failure
    - Pneumonia
    - ARDS
    - CHF
- Hypercapnic respiratory failure
    - COPD
    - Asthma
    - Hypoventilation
- Increased ventilatory demand
    - Severe sepsis or septic shock
    - Severe metabolic acidosis

Mode

Start with AC - assist control

RR (Resp Rate)

- For most patients, 12-16 bpm is reasonable but for pts with severe tachypnea, typically set about 4 breaths per minute below their native rate.
- In metabolic acidosis
    - If pt has a metabolic acidosis with respiratory compensation (i.e. 7.20/20/80/15)
        - Try to approximate their pre-intubation respiratory rate (as above, usually set about 4 bpm below the patient's native rate). If they are sedated post-intubation and RR set too low, there will be no respiratory compensation and their pH will drop which could result in cardiac arrest.
- In ARDS
    - Again try to approximate their baseline minute ventilation (4 bpm below their native rate, not to exceed 35 bpm, usual rates between 14 and 22)
    - Be cautious as excessively high rates may result in auto-PEEP
- In COPD
    - Lower rate will help to avoid auto-PEEP. Aim for < 20 and > 10 bpm.

TV (tidal volume)

Determine predicted body weight (PBW)

Males = 50 + 2.3 [height(inches) - 60]

Females = 45.5 + 2.3 [height(inches) - 60]

- Set at 8 ml/kg PBW
- In ARDS
    - Reduce by 1 ml/kg at intervals ≤ 2 hours until TV = 6 ml/kg PBW

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FiO2

- Start at 100% and decrease as able to lowest possible FiO2 to meet oxygenation goals (PaO2 > 60 mmHg, sats >90%)

PEEP

- Start at 5 cm H20. Titrate up as needed
- Remember that increasing PEEP decreases venous return to heart so will decrease cardiac output and decrease BP.
    - Works well in CHF given decreases preload
    - Can be problematic in sepsis with low BP

Inspiratory flow rate

- Start at 40 to 60 L/min to target I:E ratio of 1:2 to 1:3
- In COPD, 60-100 L/min to target I:E ratio 1:4 - may be a more reasonable goal to avoid auto-PEEP by allowing more time for exhalation

Ventilator Adjustment

Based on ABG

Minute ventilation (adjust based on pH and pCO2)

In the general patient:

- Low pH and high pCO2 - respiratory acidosis
    - Increase minute ventilation
        - Increase RR
        - Increase TV. Increasing TV is the more efficient method but avoid volumes ≥ 10 mL/kg as can result in barotrauma or ventilator-associated lung injury.
- Low pH and low pCO2 - indicates a concurrent metabolic acidosis
    - Maintain a high enough minute ventilation to allow respiratory compensation to avoid dropping pH.
    - Once the cause of the metabolic acidosis is corrected, decrease minute ventilation to avoid alkalosis
- High pH and low pCO2 - respiratory alkalosis
    - Decrease minute ventilation (either RR or TV)
- Normal pH and high pCO2
    - Seen in CO2 retainers. Usually high baseline bicarb is a clue they retain.
    - Target normal pH not pCO2

In ARDS:

- Follow ARDSnet protocol (ARDSnet.org) for low tidal volume ventilation

In COPD:
- Avoid high RR (try to keep < 25, ideally < 20) to avoid auto-PEEP
- Higher TV could result in auto-PEEP as well
- Auto-PEEP may worsen pH and CO2 in addition to increasing intrathoracic pressures
- If experiencing auto-PEEP, increase Inspiratory Flow Rate (60 to 100 mL/min) to decrease inspiration time allowing more time for exhalation

Oxygenation (goal PaO2 > 60 mm Hg, sats > 90%)

In the general patient:
- Increase FiO2
- If requiring high FiO2, increase PEEP

In ARDS:
- Use incremental FiO2/PEEP combinations as outlined in ARDSnet protocol

In COPD:
- Increase FiO2
- Typically set PEEP at 5 cm H2O. Increase PEEP if ineffective trigger efforts are observed (ineffective efforts are due to the patient having to overcome intrinsic PEEP before their effort is sensed by the ventilator - increasing PEEP will help with this)

Following Pressures

Peak pressure = measured during airflow
- Represents pressure in airways
- Increases with airway obstruction such as:
    - Bronchospasm
    - Secretions
    - Occluded ETT
    - Mucous plug

Plateau pressure = measured after airflow stops
- Represents lung compliance
- Plateau pressure target ≤ 30 cm H2O
- Increases with decreased lung compliance such as:
    - PTX
    - Pulm edema
    - ARDS
    - Pneumonia

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Sedation, Analgesia

Duration of sedation

Long
- Hemodynamically stable
    - Dexmedetomidine
    - Benzo infusion
    - Fentanyl infusion
- Hemodynamically unstable
    - Benzo infusion
    - Opiate infusion

Short
- Hemodynamically stable
    - Dexmedetomidine
    - Propofol
    - Push opiates
- Hemodynamically unstable
    - Benzo infusion
    - Maybe Dexmedetomidine
    - Fentanyl infusion

General Care on the Vent

F Feeding
A Analgesia
S Sedation
T Thromboembolic ppx

H Head of bed elevation
U Ulcer (stress) ppx
G Glycemic control
S Spontaneous breathing trial

B Bowel regimen
I Indwelling catheter removal
D De-escalation of antibiotics

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Nutrition

- Place keofeed and begin nutrition provided no bowel issues or hemodynamic instability
- For adequately nourished patients who are unable to receive enterally, do NOT initiate parenteral nutrition before 1-2 weeks have elapsed (evidence of worsened outcomes with early parenteral nutrition)
- For malnourished patients unable to receive enteral nutrition
    - Expected to last one week or less, recommend NOT starting parenteral nutrition.
    - Expected to persist longer than one week, start parenteral nutrition

Glucose control

- Goal blood glucose range 140-180 mg/dL using ISS or EndoTool depending on degree of hyperglycemia

Ventilator-associated pneumonia prevention bundles

- Basic practices with evidence of decreased duration on vent, LOS, mortality
    - Good quality evidence
        - Daily sedation interruption
        - Daily assessment of readiness to extubate
        - Spontaneous breathing trials
    - Low quality evidence
        - Head of bed 30-45º

- Practices which may lower VAP rates but unclear impact on duration on vent, LOS, mortality
    - Chlorhexidine - conflicting data regarding efficacy and safety

- PUD ppx - generally not recommended for VAP prevention

DVT ppx

- Lovenox
- Unfractionated heparin if CrCl an issue

GI ppx

- Recommended if on vent >48 hours
- PPI considered more effective than H2 blockers based on RCTs

Liberation from the Vent (Weaning)

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Daily weaning trial - perform if certain conditions met (see ARDSnet protocol)
- Lift sedation
- SBT (spontaneous breathing trial)
    - Follow ARDSnet protocol7
    - Calculate RSBI (rapid shallow breathing index or Tobin index)
        - RR/TV(in L)
            - If >105, do not extubate

Four things on check list before extubation:

1. Mechanics of ventilation good? (passed SBT)
2. Mental status good? Important for airway protection
3. Secretions - not excessive?
4. Air leak - if good leak with balloon deflated, then tracheal inflammation not an issue