COVID-19 TRAINING FOR HEALTHCARE WORKERS

Treating the Moderately Dyspneic Patient Part 2: High Flow Nasal Cannula and Non-invasive Positive Pressure Ventilation

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OVERVIEW

- High flow nasal cannula and noninvasive respiratory support, are all methods of providing additional respiratory support to patients beyond the usual therapies (nasal cannula, face mask)

WHEN ARE THESE MODALITIES USEFUL?

- Respiratory support can be thought of in a tiered approach that escalates as the patient's needs change.
- In general, we progress as follows
    - Nasal cannula
    - Non-rebreather mask
    - High flow nasal cannula
    - Noninvasive respiratory support
    - Endotracheal intubation
- As discussed in the earlier lectures, perform your assessment of the patient's respiratory status including vital signs, mental status and work of breathing
- For example, if the patient clearly is working hard to breathe (using accessory muscles, unable to speak in full sentences), they would benefit from initiation of one of these modalities
- Of course, there are scenarios where a patient will need to progress directly to intubation
    - Altered mental status
    - Inability to protect the airway
    - Large amount of secretions

HIGH FLOW NASAL CANNULA: What is it?

- Specialized oxygen delivery device
- High O_2 flow rates (>30L/min) – more efficient than conventional O_2 therapy
- Heating and humidification – prevents desiccation and irritation of the nasal mucosa
- Silicone nasal cannula – fits without occluding the nose

HIGH FLOW NASAL CANNULA: Initial parameters

- There are 2 major settings that can be adjusted
    - Flow rate (amount of air delivered in L/min)
    - Oxygen concentration (21%-100%)
- Flow rate
    - Since flow is what provides positive pressure that appears to help these patients, we recommend initially placing the patient on a fixed flow of 30L/min
- Oxygen concentration

        - Once the flow is set, start the oxygen concentration (FiO_2) at 100% and decrease by 10% at a time to the lowest FiO_2 that they remain comfortable at as judged by decreased work of breathing and respiratory rate
        - Usually an oxygen saturation of 92%-96% is the goal and the minimum FiO_2 should be used to meet this
- Temperature
    - Start with a temperature of 37°C and adjust it down to 34 or 31 degrees as tolerated by the patient
- Weaning
    - When weaning a patient, start by decreasing the FiO_2 first, then decreasing the flow rate in increments of 5L at a time

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HIGH FLOW NASAL CANNULA: Why does it work?

- Efficient oxygen delivery
    - Maintain a high FiO_2 by delivering flows higher than spontaneous inspiratory demand
- Reduced of anatomic dead space
    - During normal ventilation, approximately 30% of the tidal volume is wasted in anatomical dead space that does not participate in gas exchange
    - HFNC washes out the CO_2 of the upper airways
- Decreased work of breathing
- Small amount of PEEP
    - 1 cm H_2O per 10L/min flow
    - Which increases lung volumes and improves gas exchange

HIGH FLOW NASAL CANNULA: Aerosolization Risk

- Leonard S, et al. Preliminary Findings of Control of Dispersion of Aerosols and Droplets during High Velocity Nasal Insufflation Therapy Using a Simple Surgical Mask: Implications for High Flow Nasal Cannula. CHEST 2020.
- From prior studies, we know that a standard surgical mask could significantly reduce aerosolization with HFNC therapy
- Such a strategy does not entirely prevent particulate and airflow escape
    - PPE, HEPA filtration and negative pressure rooms remain important adjunctive measures.

NON-INVASIVE RESPIRATORY SUPPORT: What is it?

- Pressure-targeted respiratory modality
- Primarily used for COPD and cardiogenic pulmonary edema
- Mechanical ventilator attached to a tight-fitting mask
- Keeps small airways and alveoli open by providing PEEP
- Reduces the work of breathing by assisting the respiratory muscles

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NON-INVASIVE RESPIRATORY SUPPORT: PEEP vs No PEEP

- Without PEEP, the small airways and alveoli of COVID-infected lungs collapse at the end of expiration
- With PEEP, the small airways and alveoli remain open, increasing end-expiratory lung volume

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NON-INVASIVE RESPIRATORY SUPPORT: Two modalities

1. CPAP or Continuous Positive Airway Pressure ventilation
2. BiPAP or Bilevel Positive Airway Pressure ventilation

- Both modalities can provide oxygen delivery (up to 100%) and positive end expiratory pressure
- BiPAP also provides some degree of inspiratory pressure

NON-INVASIVE RESPIRATORY SUPPORT: Should I start with CPAP or BiPAP?

- Consider CPAP in patients with a tolerable work of breathing
  - They don't need mechanical inspiratory support from BiPAP
- Consider BiPAP for patients with hypercapnic respiratory failure and muscular fatigue (e.g., COPD)

NON-INVASIVE RESPIRATORY SUPPORT: Initial CPAP Parameters for COVID

- CPAP can reduce the degree of hypoxemia (even in cases that may have failed conventional oxygen therapy) through
  1. Alveolar recruitment
  2. Improved lung compliance
  3. Reduced ventilation-perfusion mismatch
- Normal Initial CPAP Parameters – for non-COVID patients
  - CPAP 5-10 cm H_2O
  - FIO_2 100%
- Normal Initial CPAP Parameters – for COVID patients
  - CPAP 10 cm H_2O
  - FIO_2 100%
  - Then, titrate FiO_2 and PEEP (may slowly increase to as high as 15-18 cm H_2O) to keep the respiratory rate below 25 and reach your target oxygen saturation

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NON-INVASIVE RESPIRATORY SUPPORT: Initial BiPAP Parameters for COVID

- Consider using BiPAP with a low driving pressure in patients with comorbidities, like COPD
- Normal Initial BiPAP Parameters – for non-COVID patients
  - EPAP 5 cm H_2O
  - IPAP 15 cm H_2O
  - Pressure support: 10 cm H_2O
  - FiO_2 100%
- Normal Initial BiPAP Parameters –for COVID patients
  - EPAP 12 cm H_2O
  - IPAP 16 cm H_2O
  - Pressure support: 4 cm H_2O
  - FiO_2 100%
  - Then, titrate FiO_2, IPAP and EPAP to reduce the work of breathing, keep the respiratory rate below 25 and achieve your target oxygen saturation

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NON-INVASIVE RESPIRATORY SUPPORT: Reducing the risk of transmission

- Theoretical concern for viral transmission with the use of CPAP and BiPaP
- Viral filter
  - Can mitigate the risk by creating a closed system and limiting transmission

    - Attach directly to the mask – as long as the filter and mask are compatible
    - For one-limb systems, attach to the inflow limb and exhaust port
- Proper mask seal

NON-INVASIVE RESPIRATORY SUPPORT: Patient requirements

- Conscious
- Able to initiate their own breaths
- Able to maintain their own airway
- No facial abnormalities that would prohibit mask seal

CHOOSING BETWEEN HIGH FLOW NASAL CANNULA AND NON-INVASIVE RESPIRATORY SUPPORT

- If your patient is in respiratory distress but does not appear fatigued – consider HFNC therapy
- If your patient appears to be fatiguing and fails a trial of HFNC, then consider Non-Invasive Respiratory Support
    - Assume that your patient is fatiguing if they have rapid shallow breathing, are tiring after prolonged respiratory distress, or have asynchronous movements of the chest and abdomen.

FINAL POINTS

- Frequent assessment of a patient's work of breathing as well as vital signs is key
- Respiratory support can be seen as an escalating ladder with several options before intubation
- Both high flow nasal cannula and noninvasive respiratory support are options for patients with severe dyspnea prior to intubation
- High flow nasal cannula is preferred, with noninvasive positive pressure ventilation (ideally continuous positive pressure ventilation) as the next best option
- Whatever modality you use, reassessment and titration of these modalities is important as well as determining whether they require intubation