Hypoxemia, Oxygen Delivery & Treatment Modalities in Cystic Fibrosis

• Matthew Dartt RRT
Disclosure

- I have no conflict of interest to disclose
Objectives:

• Define Hypoxia
• Describe different Oxygen delivery devices and when to start them
  • NC-Mask
  • HFNC
  • BiPAP
  • Intubation/Ventilator
• List and discuss general Respiratory modalities in CF
  • Nebs
  • Vest
  • Huff Coughing
Hypoxia/Hypoxemia

• Hypoxia-
  • The failure of the tissues, for any reason, to receive an adequate supply of oxygen, is known as hypoxia.

• Hypoxemia-
  • abnormally low levels of oxygen in the blood.
Why is Respiratory so Important?

• Cystic Fibrosis is a complex multiorgan disease.

• Lung disease accounts for nearly_____ of the mortality?

• 85%
Mucociliary Clearance and Obstruction

- Periciliary Liquid (PCL)
- Surface Epithelial Cells
- Tenacious Mucus
When to Start O2

• PEDS
  • Day Time SpO2 ≤ 95 % on Room Air
  • Noc Time SpO2 ≤ 93% on Room Air

• ADULTS
  • SpO2 ≤ 90-92% on Room Air

• Therapeutic O2 for CF?
  • No real benefits
Basic O2 set ups

• NC 1-5 Lpm add humidity

• Simple Mask 6-10 Lpm add humidity

• NRB 10- Flush
  • Flow must be sufficient to keep reservoir bag from deflating upon inspiration
  • Patient is most likely decompensating. The Physician and RT should be notified immediately
Nasal Cannula
Simple mask
NRB Mask
HFNC– High Flow Nasal Cannula

• Nasal high flow oxygen therapy offers another option for patients requiring respiratory support.

• Nasal high flow oxygen therapy allows delivery of a prescribed FiO2 with reduced air entrainment and dilution.

• This therapy may be beneficial in that nasal interfaces may be better tolerated and children receive the benefits of humidification and likely also receive a low level positive airway pressure.

• Wean FIO2 first and then flow.
Beginning FLOW RATES

- < 32 wks.. – 1 to 2 lpm
- > 32 wks. – 2 to 3 lpm
- Infants – 6 to 8 lpm
- Toddlers through adolescents – 10 to 25 l/m
- Teens - 15 to 25 lpm or greater as tolerated by the patient
- Adults 20-60 lpm

At these flow rates the nose will not be able to warm the inhaled O2. This increases the risk of bronchospasm associated with cold medical gas and mucus plugging as well.
HFNC
BiPAP

• BIPAP therapy improves the respiratory status of decompensating end-stage CF patients.

• It is well tolerated for long-term home use and provides an extended period of respiratory comfort and stability for CF patients awaiting lung transplantation.
BiPAP cont.
BiPAP initial settings (guidelines)

- Adults
  - IPAP 10
  - EPAP 5

- Peds
  - IPAP 8
  - EPAP 4
BiPAP Settings cont.

- IPAP = Ventilation
- EPAP = Oxygenation
Contraindications/Exclusion Criteria

- Uncooperative patient
  - Extreme anxiety
  - Decreased level of consciousness
  - Agitated, combative
  - Confusion

- Inability to protect airway
  - Inability to clear secretions
  - Copious secretions as in CF!
  - High risk of aspiration (e.g. bowel obstruction)
  - Cardiac/respiratory arrest
NIV failure

- Lack of improvement in arterial blood gases
- Severe acidosis pH < 7.25
- Hypercapnia PaCO₂ > 60 mmHg
- Hypoxemia PaO₂:FiO₂ < 200 mmHg (P/F Ratio)
- Tachypnea > 35 BPM (Adults)
- Peds is going to depend on their age and the situation
When NIV fails

• If you are failing to ventilate or oxygenate properly with BiPAP and the patient cannot maintain a patent airway or adequately clear secretions time to …

• Intubate and place on a ventilator
What indicates success on NIV in our CF Patients?

- The same indicators as other patients:
  - Decrease in WOB
  - Decrease in respiratory rate
  - Decrease use of accessory muscles
  - Decrease in PaCO2 and/or an increase in PaO2
Common Nebulized Medications

• **Bronchodilator**

• **Hypertonic Saline usually 7% 3-5ml**
  - HS and BD With a full vest for 20 minutes sitting straight up using a mouthpiece always (when pt. is able) nice slow deep breaths.
  - 10 minutes then HUFF cough for 1-3 minutes (3 to 5 cycles of huffing and resting) then 10 more minutes on the vest.
  - Remember Hypertonic can cause bronchospasm so always pre-medicate with bronchodilator

• **Pulmozyme:**
  - Used to break down extra cellular DNA left by white blood cells when fighting bacteria trapped in the lungs. Which cause thick and sticky mucus.

• **Wait 30 minutes and then give antibiotic:**
  - Tobramycin
  - Cayston
Disposable Pari Neb

Pulmozyme
Tobramycin
Pari Neb cont.

- Inpatient setting this neb needs to be clearly labeled with start date and time along with the medication it is being used for.

- It is good for 15 uses

- Clean with sterile water, dry with paper towel and air dry on paper towels in a clean basin with clean towels.

- Use the unit dose of medication for the Pari neb.

- Do not dilute Pulmozyme or Tobramycin with saline.
Altera Nebulizer for Cayston

- Rinse under water for approx. 10 sec
- Wash in warm water and clear liquid soap
- Rinse under warm water
- Air dry on lint free towel or clean paper towel
- You can disinfect the equipment using an electronic baby bottle steam sterilizer
- Do NOT use a MICROWAVE steam sterilizer with the Altera handset!
Keeping our Equipment clean

• Cleaning Respiratory Equipment

• Germs can get on respiratory equipment and cause lung infections.

• What can we do?
  • Inpatient changing out dirty visibly soiled equipment daily and as needed.
  • Keeping it separate clean and dry.
  • Educating the patient on in and outpatient cleanliness of Airway Clearance devices and Nebulizers.
Keeping our Equipment Clean cont.
Keeping our Equipment Clean cont.
In multiple studies, Pseudomonas was found in 100% of ICU sinks.
Cleaning of Nebulizers cont.

- The nebulizer parts must be cleaned before they can be disinfected. With a new paper towel, wash the inside and outside of the nebulizer parts with clear liquid dish soap and hot water. Be careful not to damage any of the parts.

- Throw the paper towel away, then rinse the nebulizer parts with water. Clean the nebulizer right after it is used to keep the medicine and debris from drying. Once debris dries, it is difficult to wash off.

- You also can clean the nebulizer parts in an automatic dishwasher if the nebulizer’s manufacturer’s instructions allow. Obviously inpatient this is not feasible.
Cleaning of Nebulizers cont....

- **Disinfect the nebulizer parts.**
  - DO NOT USE VINEGAR. Vinegar is not strong enough to kill the germs a person with CF might get.
  - Instead, ask your CF care team what is the best way to disinfect the nebulizer parts. Some options are:
    - Using an electronic steam sterilizer (e.g., used for baby bottles)
    - Boiling (in water) for 5 minutes
    - Microwaving (in water) for 5 minutes
    - Washing in dishwasher, if the water is hotter than 158°F, for 30 minutes
    - Soaking in 70 percent isopropyl alcohol for 5 minutes
    - Soaking in 3 percent hydrogen peroxide for 30 minutes
  - Read the manufacturer’s instructions to learn about cleaning and disinfecting your nebulizer. Do not use a nebulizer that cannot be disinfected.

- **Rinse the nebulizer parts.**
  - If you disinfect with isopropyl alcohol or hydrogen peroxide, rinse all parts well with sterile water.
  - DO NOT USE WATER FROM THE FAUCET, BOTTLED WATER OR DISTILLED WATER. You can make water sterile by boiling it for 5 minutes. Use this water once, then throw it out. If you disinfect by other methods, you do not need to rinse the nebulizer.

- **Air-dry the nebulizer parts.**
  - After the final rinse, drain the parts on a clean surface covered with new paper towels. Replace wet paper towels with dry ones and fully air-dry all parts. Germs will grow on anything that stays wet. Store the dry nebulizer in a clean, dry bag in a clean, dry place.
  - Some respiratory equipment may need to be cleaned but not disinfected. These items can be cleaned often with liquid soap and hot water. Ask the respiratory therapist, the nurse or physician at your CF care center, how often to clean your equipment and the best way to do so.
Vest Therapy

• Prescribe the Frequency (Hz) and Pressure settings for the treatments:

  • Frequencies between 10 and 14 Hz are commonly used.

  • For toddlers and young children, use 10 Hz
  • For older children, adolescents, and adults: start at 10 Hz then ramp up to 14 Hz
  • Depending on the type of Vest, the common settings for Pressure are:

    • Chest vest = 1 – 4
    • Full vest = 5 – 6
    • Wrap vest = 1 – 4
Chest Vest

- Wrap Vest
- Chest Vest
- Full Vest
Vest Use cont.

• Patients should receive HFCC (*high-frequency chest compression*) vest therapy for 20 minutes at least twice a day.

• Have them use Vest with aerosol treatment for 10 minutes, pause to huff-cough, then complete the final 10 minutes of treatment.

• WITH AEROSOL TREATMENT
Vest Use cont.

• To avoid problems with the stomach i.e. vomiting try to do the vest treatments **before meals or no sooner than one hour after meals**

• Do the vest treatments **two times a day**: in the morning when they wake up, and again in the evening.

• We can increase the vest treatments up to **four times a day** as tolerated during exacerbations with doctor approval and patient tolerance.
Coughing

• A cough is our natural reflex that protects your lungs. Coughing helps clear your airways of lung irritants, such as smoke and mucus.

• This helps prevent lung infections.
Huff Coughing

• How Long:
  
  • You should never Huff Cough to the point of exhaustion!
  
  • Perform 2 or 3 huff breaths
  
  • Cough when you feel the mucus collected in your upper airway
  
  • Rest for a while (5 to 10 breaths)
  
  • Try to do 3 to 5 cycles of huffing and resting
**Huff Coughing Cont.**

**To Do Huff Cough:**
- Begin in a sitting position with your chin slightly upward
- Use your diaphragm (stomach muscle) to breathe in slowly
- Hold the breath for 2 to 3 seconds
- Force the breath out your mouth in one quick burst of air
- Make sure the back of your throat is kept open

**Adjusting the therapy:**
- The length and force of the breath will change depending on where mucus is cleared from
  - A normal size breath out clears the larger breathing tubes
  - A longer breath out clears the smaller breathing tubes
- You should do both to get the best therapy
Diaphragmatic Breathing Can:

- Reduce Stress
- Panic Attacks
- General Fatigue and headaches
- Improve lung expansion if done correctly.

http://en.wikipedia.org/wiki/Diaphragmatic_breathing#mediaviewer/File:Diaphragmatic_breathing.gif
Metaneb

Provides three different modes of therapy.
CPEP Continuous positive expiratory Pressure
CPEP cont.

CPEP
Air moves beyond the retained secretions to aid in secretion mobilization and reduces the incidence of air trapping
CHFO – Continuous High Frequency Oscillation
Happy Lungs
What is the best modality for CF??

• No Single Modality alone is the answer.

• Cystic Fibrosis is a complicated disease that requires a multi-disciplinary approach and teamwork in order fit the needs of the patient and the disease.
References:

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