Chapter 14
Respiratory Emergencies

Learning Objectives
- Define nasal cannula, rebreather face mask, nonrebreather face mask, and Venturi mask
- Discuss use of O₂ in a respiratory emergency
- Describe two types of bronchodilator agents

Learning Objectives
- Discuss benefits of the metered-dose inhaler
- Demonstrate proper procedure for administering medication through metered-dose inhaler
Learning Objectives

- Discuss medications used in treatment of asthma:
  - Albuterol (Proventil, Ventolin)
  - Ipratropium bromide (Atrovent)
  - Albuterol/ipratropium (Combivent)

Learning Objectives

- Discuss medications used as second-line therapy for acute exacerbation of asthma:
  - Methylprednisolone sodium succinate (Solu-Medrol)
  - Hydrocortisone sodium succinate (Solu-Cortef)
  - Aminophylline
  - Magnesium sulfate
  - Racemic epinephrine

Learning Objectives

- Briefly describe key treatment for patients with chronic obstructive pulmonary disease
Introduction

- Prehospital treatment of respiratory distress has produced positive outcomes
  - Increased survival rates
  - Shorter hospital stays
  - Decreased cost to healthcare system

- Prehospital care is aimed at treatment of reversible bronchial constriction

Oxygen

- Most commonly used medication in prehospital care

- Colorless and odorless gas

- Stored in green or aluminum cylinders at pressure of 1800 to 2400 psi

- As O₂ passes through attached regulator, gas pressure is decreased to working pressure of 60 psi

- Contained in nine different sizes of cylinders labeled alphabetically
Oxygen

- Quantity delivered is considered in terms of inspired O₂ and flow
  - Atmosphere consists of 78% nitrogen, 21% O₂, and 1% of variety of gases
  - Fraction of inspired O₂ (FiO₂)
    - Concentration of inspired O₂
  - Normal room air has 21% O₂
  - When supplemental O₂ is given, it increases content of O₂ in blood and subsequently to the heart and peripheral tissues

O₂ delivery devices

- Nasal cannula
  - Creates reservoir filled with O₂-enriched gas
  - When patient inhales, he or she breathes from reservoir
  - Noninvasive means of delivering supplemental O₂ in low-flow fashion
  - O₂ flows through two nasal prongs into oropharynx
  - Acts as O₂ reservoir
  - Increases O₂ concentration
  - Set with a flow rate of 6 L/min delivers O₂ concentration between 35% and 45%
Oxygen delivery devices

Masks are capable of delivering O₂ concentration based on:

- Flow rate
- Reservoir of mask
- Presence or absence of reservoir bag
- Side ports in mask with directional valves

Simple O₂ mask

- Does not have reservoir bag or side ports
- Room gases mix with O₂ inside mask
- At flow rate of 6 to 10 mL/min, can deliver FiO₂ between 30% and 60%
Oxygen

* O₂ delivery devices
  * Rebreather face masks/partial rebreather face masks
    * Have face mask and reservoir bag
    * O₂ accumulates in reservoir bag
    * During inspiration, patient inhales O₂ in reservoir and some room air through side ports
    * Upon exhalation, some of the expired breath goes back into reservoir bag, where it is rebreathed
    * Partial rebreather masks can deliver 60% O₂
  * Nonrebreather face masks
    * Similar to rebreather in appearance and function
    * Have one-way exhalation valves on sides of the mask and reservoir bag
    * Valves on sides of the mask prevent inhalation of room air
    * Valve on reservoir prevents any exhaled breath from entering O₂-rich reservoir
    * Require higher flow rate of 12 to 15 mL/min
    * Can deliver O₂ concentrations close to 100%
Oxygen delivery devices

- Venturi mask
  - Used by EDs
  - Have series of small plastic inserts that fit ports on the mask
  - Regulate concentration of O₂ patient can inhale
  - By changing plastic insert, provider can alter O₂ concentration from 24% to 60%
  - Flow of O₂ depends on desired FiO₂
Oxygen

- Initiation of $O_2$ therapy
  - Equipment needed:
    - $O_2$ source
    - $O_2$ flow meter
    - Mask or cannula

- Procedure:
  - Observe universal precautions
  - When possible, explain to the patient what procedure you are performing and why
  - Ensure the protective seal has been removed from the valve on the tank
  - Quickly open and close valve to blow out any dirt or contaminants out of the tank opening

- Procedure:
  - Place washer over the inlet port on the regulator
  - Open the tank to test for an airtight seal
  - Adjust the flow meter to the desired setting
  - When finished, turn off flow meter and close tank valve
  - Open flow meter momentarily to release pressure from the regulator
**Oxygen**

- Patients who require continuous $O_2$ at home can require transtracheal catheter
  - Inserted surgically
  - Used for long-term $O_2$ therapy in patients with chronic lung disease
  - Held in place by a necklace

**Bronchodilators**

- Patients with asthma and COPD have respiratory distress from functional narrowing of conducting airways
  - Bronchospasm
    - Spasm of bronchial smooth muscle
    - Results in decrease in airway diameter
  - Edema of mucosa that lines respiratory tract
    - Results in thickening of mucosal linings and resultant decrease in airway diameter
    - Increased secretions

**Poiseuille’s law**

- Law of physics that determines resistance and flow of gas
- Flow of gas through a tube is proportional to radius of the airway to fourth power
Bronchodilators

- Selective agents
  - Act preferentially on bronchial smooth muscle
  - Improves patient's condition while minimizing side effects
  - Beta2 agonists are sympathomimetic medications that target beta2 receptors
  - Excessive doses can produce effects seen with alpha and beta1 stimulation

- Use with caution in patients with history of heart disease
- Always monitor ECG during and after treatments
- Examples:
  - Albuterol (Proventil)
  - Terbutaline (Brethine)
  - Metaproterenol (Alupent)
  - Formoterol (Foradil)
  - Pirbuterol (Maxair)

- Nonselective agents
  - Act on alpha, beta1, and beta2 adrenergic receptors
  - Alpha receptors
    - Stimulation causes constriction of peripheral blood vessels
    - Results in BP elevation
  - Beta1 receptors
    - Primarily located in cardiac tissue
    - Stimulation causes increased heart rate and cardiac contractility
Bronchodilators

- Nonselective agents
  - Beta_2 receptors
    - Stimulation results in bronchodilation by relaxation of bronchial smooth muscle
  - Example:
    - Racemic epinephrine

Inhalation Delivery of Medications

- Delivery of beta_2-specific medications can be accomplished by:
  - Nebulization
  - Parenteral administration
  - Oral administration

Inhalation Delivery of Medications

- Nebulizer
  - Instrument that converts liquid medication into fine mist to be inhaled
  - Pneumatic nebulizer uses gas as driving force to make conversion
  - Ultrasonic nebulizers use ultrasonic sound for conversion
  - Most effective method of administration
  - Delivers small particles of medication directly to receptor site in the lung by inhalation
Inhalation Delivery of Medications

- Nebulization therapy
  - Equipment needed:
    - Nebulizer unit
    - O₂ source
    - Medication

Procedure:
- Observe universal precautions
- Verify drug order
- Confirm right patient, right medication, right dose, right route, and right time
- When possible, explain to patient what medication you are going to administer and why
- Prepare all necessary equipment and medication to be administered

- Expose medication cup by unscrewing lid
- Add medication to cup, and reattach lid
- Attach mouthpiece and tubing to the nebulizer
- Connect O₂-connecting hose to appropriate connector on nebulizer cup
- Attach other end of O₂ tubing to O₂ source, and adjust flow of O₂ to 6 L/min
Inhalation Delivery of Medications

- **Procedure:**
  - Instruct patient to hold nebulizer mouthpiece in his mouth and breathe as deeply as possible
  - Monitor patient throughout treatment, and reassess ventilator adequacy and vital signs after treatment has been completed
  - Repeat treatment if needed, and provide supplemental O₂ as needed
  - Record time of drug administration in PCR
  - Evaluate patient for desired effects of medication and any adverse effects

Inhalation Delivery of Medications

- **Metered-dose inhaler (MDI)**
  - Delivers predetermined amount of medication in correct particle size propelled by small amount of gas
  - Has two parts: canister and mouthpiece
  - If used improperly, medication will not reach its intended site in the lung
Inhalation Delivery of Medications

- MDI
  - Spacer device
    - Facilitates slower movement of medication particles
    - When spacer is not available, holding MDI 2 inches from mouth also causes particles to slow

Inhalation Delivery of Medications

- MDI use
  - Equipment needed:
    - MDI with medication
    - PPE

Inhalation Delivery of Medications

- MDI use
  - Procedure:
    - Observe universal precautions
    - Verify drug order
    - Confirm right patient, right medication, right dose, right route, and right time
    - Confirm with patient that no allergies to the medication
    - When possible, explain to patient what medication you are going to administer and why
    - Shake inhaler for 5 to 10 sec
Inhalation Delivery of Medications

- MDI use
  - Procedure:
    - Insert outlet tube into patient’s mouth
    - Direct patient to squeeze ends of medication canister to deliver the medication
    - Instruct patient to inhale a slow, full, deep breath
    - Instruct patient to hold breath for up to 5 sec if possible
    - Repeat if indicated
    - Record time of drug administration in the PCR
    - Evaluate patient for desired effects of the medication and any adverse effects

- MDI with spacer
  - Equipment needed:
    - MDI with medication
    - Spacer
    - PPE

Inhalation Delivery of Medications

- MDI with spacer
  - Procedure:
    - Observe universal precautions
    - Verify drug order
    - Confirm right patient, right medication, right dose, right route, and right time
    - Confirm with patient that no allergies to the medication
    - When possible, explain to patient what medication you are going to administer and why
    - Shake inhaler for 5 to 10 sec
Inhalation Delivery of Medications

- MDI with spacer
  - Procedure:
    - Insert outlet tube into spacer
    - Instruct patient to place spacer device into his mouth and close lips over it
    - Direct patient to squeeze ends of the medication canister to deliver medication
    - Instruct patient to inhale a slow, full, deep breath
    - Instruct patient to hold the breath for up to 10 sec if possible
    - Wait approximately 60 sec and repeat
    - Reassess breath sounds, vital signs, and ventilations
    - Record time of drug administration in the PCR
    - Evaluate patient for desired effects of the medication and any adverse effects

Overview of Asthma

- Caused by trigger reaction
  - Intrinsic trigger
    - Within the body
    - Exertion
    - Anxiety
  - Extrinsic trigger
    - Outside the body
    - Animal dander
    - Dust
    - Insect droppings
    - Pollen
    - Cleaning chemicals
Overview of Asthma

- Management
  - Avoid or mitigate triggers
  - Reverse acute bronchospasm
  - First line is inhaled beta₂-specific drugs
  - If inhaled bronchodilators fail, initiate IV medications
  - Albuterol (Proventil, Ventolin)
    - Most common
    - Targets only the beta₂ receptor

- Management
  - Previous beta₂ agonists had varying effects on alpha and beta₂ receptors
    - Stimulation of alpha and beta₂ sites cause unwanted reactions
      - Vasoconstriction
      - Increased heart rate

- Management
  - First generation drugs have significant beta₁ effects with beta₂ effects
  - Second generation drugs were more beta₂ specific, but still increased the heart rate
  - Third generation drugs target beta₂ receptors
    - Have little systemic effects
    - Multiple and continuous treatments can be given
Overview of Asthma

Management

- Levalbuterol (Xopenex)
  - Purified form of albuterol
  - As effective as albuterol
  - Results in fewer undesirable side effects
    - Tachycardia
    - Tremors

- Ipratropium bromide (Atrovent)
  - Used in more severe exacerbations or with limited response to albuterol
  - Anticholinergic
    - More effective in peripheral airways
    - More relief for patients with COPD
  - Albuterol/ipratropium (Combivent)
    - Combination product

- Patient gasping for breath
- Using accessory muscles of respiration
- Wheezing
- Corticosteroids treat inflammatory processes in asthma and COPD
Overview of Asthma

- Management
  - Second line therapy for acute exacerbation of asthma
    - Peak expiratory flow rate (PEFR)
      - Objective assessment to determine severity of exacerbation
      - When less than 50%, corticosteroids should be administered after ipratropium bromide
      - Corticosteroids should be considered when PEFR does not improve by at least 10% after bronchodilator therapy or when PEFR is less than 70% after 1 hour of therapy

- Management
  - Second line therapy for acute exacerbation of asthma
    - Aminophylline
      - Reduces smooth muscle bronchospasm associated with acute respiratory distress
      - Can reach therapeutic levels quickly
      - Has narrow therapeutic index
      - Begin by administering loading dose to place serum levels in therapeutic range

- Management
  - Second line therapy for acute exacerbation of asthma
    - Aminophylline
      - Maintenance infusion is required to keep at therapeutic level
      - Patients with renal or hepatic dysfunction can have impaired secretions
      - Smokers or tobacco chewers need higher levels
      - Generally not used in the prehospital field
Overview of Asthma

- Management
  - Second line therapy for acute exacerbation of asthma
    - Magnesium sulfate
      - Decreases bronchospasm in some patients with asthma
      - Used when patients have inadequate response to beta2 agonists

- Epinephrine
  - Has strong beta2 effects
  - Strong undesirable alpha and beta1 effects
  - Rebound bronchospasm can occur
  - Effects are short lived
  - Use with caution

COPD

- Obstruction in the pulmonary tree
- Emphysema
- Chronic bronchitis
- Increase in sputum production and resultant bronchospasm
COPD

- Management
  - Oxygenation and ventilation
  - Patients with COPD breathe on hypoxic respiratory drive
    - Requires mild degree of hypoxia to continue breathing
      - If patient is given too much O₂:
        - Hypoxic respiratory drive is removed
        - Stimulus for spontaneous respirations is removed
  - Bronchodilators and steroids are used for treatment

Questions?