Chapter 8
The Airway

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  - Manual Positioning
  - Airway Adjuncts
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Overview
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The Respiratory System

- The respiratory system takes oxygen from the air and makes it available for the blood to transport to every cell and rids the body of excess carbon dioxide.

The Respiratory System

- The Airway
  - Upper airway
    - Extends from the mouth and nose to the trachea
  - Lower airway
    - Extends from the trachea to the alveoli

The Upper Airway

- [Diagram of the upper airway showing various anatomical structures like nasal cavities, palate, pharynx, larynx, trachea, and lungs.]
The Upper Airway

- Nose and mouth
  - Pharynx
    - Oropharynx
    - Nasopharynx
  - Epiglottis
    - Leaf-shaped structure that prevents food and liquid from entering the trachea during swallowing

The Lower Airway

- Trachea (windpipe)
- Cricoid cartilage
  - Firm cartilage ring forming the lower portion of the larynx
  - Larynx (voice box)
  - Bronchi
    - Two major branches of the trachea to the lungs; bronchus subdivides into smaller air passages ending at the alveoli
- Lungs
- Diaphragm
Respiratory Terminology

- **Ventilation**
  - The movement of air

- **Respiration**
  - The exchange of gases

Ventilation

- **Inhalation (active)**
  - Diaphragm and intercostal muscles contract, increasing the size of the thoracic cavity.
  - Diaphragm moves slightly downward, flares lower portion of rib cage.
  - Ribs move upward/outward.

*This creates a negative pressure in the chest cavity.*

Ventilation

- Air flows into the lungs because of the negative pressure.
Ventilation

- **Exhalation**
  - Diaphragm and intercostal muscles relax, decreasing the size of the thoracic cavity
    - Diaphragm moves upward
    - Ribs move downward/inward
  - Air is expelled from the lungs

Respiration

- **Alveolar respiration**
  - Gas exchange in the lungs

- **Cellular respiration**
  - Gas exchange in the tissues of the body

Alveolar Respiration

- **Alveolar/capillary exchange**
  - Oxygen-rich air enters the alveoli during each inspiration
  - Oxygen-poor blood in the capillaries passes into the alveoli
  - Oxygen enters the capillaries as carbon dioxide enters the alveoli
Cellular Respiration

- Capillary/cellular exchange
  - Cells give up carbon dioxide to the capillaries
  - Capillaries give up oxygen to the cells

Normal Breathing

- Normal respiration should be effortless

Normal Respiratory Rates

- Adult—12-20/minute
- Child—15-30/minute
- Infant—25-50/minute
Assessing Breathing

- Rate
- Rhythm
- Quality
- Breath sounds
- Chest expansion
- Effort of breathing
- Depth (tidal volume)

Effort of Breathing

- Accessory muscles
  - Additional muscles used to draw air into the chest
  - Includes the muscles of the neck, abdomen, and chest

*Use of accessory muscles is a sign of respiratory distress!*

Tidal Volume

- The amount of air exchanged in one breath
Considerations for Infants and Children

Adults versus Children
Respiratory Anatomy

- Mouth and nose
  - In general, all structures are smaller and more easily obstructed than in adults

- Tongue
  - Infants' and children's tongues take up proportionately more space in the mouth than adults

- Trachea (windpipe)
  - Narrower tracheas that are obstructed more easily by swelling
  - Softer and more flexible in infants and children

- Cricoid cartilage
  - Less developed and less rigid

- Chest wall is softer
  - Tend to depend more heavily on the diaphragm for breathing
Oxygen Sources

- Common sizes of oxygen cylinders
- Tanks must be handled carefully since their contents are under pressure.

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Equipment for Oxygen Delivery

- Oxygen regulators
  - To deliver the oxygen to the patient at the correct pressure and flow rate, a regulator is used
  - The regulator attaches to the valve of the tank to control the flow of oxygen

Attaching the regulator

- Remove protective seal
- Quickly open, then shut the valve
- Attach regulator-flowmeter to tank
- Attach oxygen device to flowmeter
- Open flowmeter to desired setting
- Apply oxygen device to patient

Video Clip: Attaching the Regulator to the Oxygen Tank
Equipment for Oxygen Delivery

Oxygen Masks

- Nonrebreather mask
- Preferred method of giving oxygen to prehospital patients
- Up to 90% oxygen can be delivered
- Nonrebreather bag must be full before mask is placed on patient
- Flow rate should be adjusted so that when patient inhales, bag does not collapse (15 L/min)

Indications for the nonrebreather mask
- Any adequately breathing patient with signs or symptoms of respiratory distress
- Any patient with potential or actual hypoperfusion
- Any other patient who would benefit from high-flow oxygen
Equipment for Oxygen Delivery

- Nasal cannula
  - Rarely the best method of delivering adequate oxygen to the prehospital patient
  - Should be used only when patients will not tolerate a nonrebreather mask, despite coaching from the EMT-Basic

Equipment for Oxygen Delivery

- Indications for the nasal cannula
  - Patients who will not tolerate a mask
  - Medical patients without respiratory compromise
  - Stable cardiac patients without signs or symptoms of cardiac compromise
  - Patients with COPD who are not in respiratory distress

Opening the Airway

Manual Positioning
Opening the Airway

- Head-tilt chin-lift when no neck injury suspected

Opening the Airway

- Jaw thrust when EMT-Basic suspects spinal injury

Assess the need for suctioning. Remember that a noisy airway is a bad airway.
Airway Adjuncts

Oropharyngeal Airways

- May be used to assist in maintaining an open airway on unresponsive patients without a gag reflex
- Patients with a gag reflex will vomit

Airway Adjuncts

- The oral airway displaces the tongue.
Airway Adjuncts

- Oropharyngeal airways
  - Insertion technique

Video Clip: Method for Inserting the Oral Airway (in Adults Only)

Video Clip: Method for Inserting the Oral Airway (Preferred Method for Infants and Children)
Nasopharyngeal Airways

- Less likely to stimulate vomiting
- May be used on patients who are responsive but need assistance keeping the tongue from obstructing the airway

Even though the tube is lubricated, this is a painful stimulus
Airway Adjuncts

- Nasopharyngeal airways
  - Insertion technique

Video Clip: Inserting a Nasopharyngeal Airway (All Ages)

Suction
Suction

- **Purpose**
  - Remove blood, other liquids, and food particles from the airway
  - Some suction units are inadequate for removing solid objects like teeth, foreign bodies, and food

  *A patient needs to be suctioned immediately when a gurgling sound is heard with artificial ventilation.*

Suction

- **On-board suction devices**

- **Portable suction units**

Suction

- **Suction catheters**
  - Hard or rigid ("tonsil sucker," "tonsil tip")
    - Used to suction the mouth and oropharynx of an unresponsive patient
    - Should be inserted only as far as you can see
    - Use rigid catheter for infants and children, but take caution not to touch back of airway
Suction

- Suction catheters
  - Soft (French)
    - Useful for suctioning the nasopharynx and in other situations when a rigid catheter cannot be used
    - Should be measured so that it is inserted only as far as the base of the tongue

Suction

- Techniques

Video Clip: Adult Suctioning

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Artificial Ventilation

Techniques of Ventilation

Preferred ventilation techniques
- Mouth-to-mask
- Two-person bag-mask
- Flow-restricted, oxygen-powered ventilation device
- One-person bag-mask

Principles
- Provide highest percentage of oxygen available
- Maintain an open airway
- Ensure an airtight seal
- Prevent gastric distention
- Ventilate patient with an adequate rate and volume
Ventilation Techniques

- Mouth-to-mask with supplemental oxygen
  - Technique

Video Clip: Mouth-to-Mask Ventilation with Supplemental Oxygen

Ventilation Techniques

- Indications for the bag-mask
  - Respiratory arrest
  - Cardiopulmonary arrest
  - To assist inadequate breathing
  - To hyperventilate patients in specific situations
Ventilation Techniques

- Features of the bag-mask
  - Self-refilling bag that is either disposable or easily cleaned/sterilized
  - Valve allowing maximum oxygen inlet flow rate of 15 L/min
  - Standardized 15/22-mm fittings
  - Inlet and reservoir to allow high-oxygen concentration

Ventilation Techniques

- Features of the bag-mask
  - One-way valve that prevents rebreathing of exhaled air
  - Constructed of materials that work in all environments
  - Available in infant, child, and adult sizes

Ventilation Techniques

- Two-person bag-mask
  - Technique
Video Clip: Two-Person Bag-Valve-Mask Procedure

Ventilation Techniques

- One-person bag-mask
  - Technique

Video Clip: One-Person Bag-Valve-Mask Ventilation Procedure
Ventilation Techniques

- Flow-restricted, oxygen-powered ventilation devices
  - Technique

Video Clip: Flow-Restricted, Oxygen-Powered Ventilation Procedure

Ventilation Techniques

- Considerations for trauma patients
  - Unresponsive trauma patients are an airway challenge
  - Spinal injuries require special care
  - Ventilations must be modified to account for spinal injuries
Video Clip: Modifying Ventilation Techniques for Trauma Patients

Ventilation Techniques
Assessing the Adequacy of Artificial Ventilation

- Signs of adequate ventilation
  - The chest rises and falls with each artificial ventilation
  - The rate is sufficient, approximately 12 per minute for adults, 12-20 times per minute for children and 20 times per minute for infants
  - Heart rate returns to normal with successful artificial ventilation
Ventilation Techniques

- Signs of inadequate ventilation
  - The chest does not rise and fall with artificial ventilation
  - The rate is too slow or too fast
  - Heart rate does not return to normal with artificial ventilation

Special Situations in Airway Management

- Patients with laryngectomies (stomas)
Special Situations in Airway Management

- **Tracheostomy**
  - An artificial permanent opening in the trachea
  - A breathing tube may be present. If it is obstructed, suction it
  - Some patients have partial laryngectomies

Ventilating Infants and Children

- Place head in correct neutral position for the infant and extend slightly past neutral for a child
- Avoid excessive hyperextension of the head
- Avoid excessive bag pressure—use only enough to make chest rise
**Special Situations in Airway Management**

- Ventilating infants and children
  - Ventilate with bag-mask until adequate chest rise occurs
  - Do not use pop-off valve; must be disabled (placed in closed position) to adequately ventilate child or infant
  - Gastric distention is more common in children
  - An oral or nasal airway may be considered when other procedures fail to provide a clear airway

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**Facial Injuries**

- The blood supply to the face is so rich, blunt injuries to the face frequently result in severe swelling
- Bleeding into the airway from facial injuries can be a challenge to manage
Dental appliances

- Dentures
  - Ordinarily dentures should be left in place
  - Partial dentures (plates) may become dislodged during an emergency
  - Leave in place, but be prepared to remove them if they become dislodged
Summary

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