Chapter 9
Airway Management

Objectives

- Describe the anatomy of the upper airway including the mouth, nose, pharynx, epiglottis, and larynx
- Identify the three regions of the pharynx
- Recall the anatomic relationship of the larynx to the tongue, pharynx, epiglottis, vocal cords, and esophagus
- Relate the difference between true and false vocal cords

Objectives

- Recall and demonstrate the essential elements of assessing airway patency, breathing effectiveness, and oxygenation in the ill or injured patient
- Identify the common mechanisms of upper airway compromise and describe the procedures for resolving each
- Describe and demonstrate the procedures used to manually open the airway
Objectives

- Discuss indications, contraindications, and methods for insertion and use of the following:
  - Oropharyngeal airway
  - Nasopharyngeal airway
  - LMA
  - Combitube airway

Objectives

- Discuss the indications, contraindications, and methods of performing suctioning
- Identify the common mechanisms of ventilatory failure and describe the procedures for resolving each

Objectives

- Discuss indications, contraindications, and methods for use of the following:
  - Pocket mask
  - Bag-mask device
  - Demand valve resuscitator
- Identify the common mechanisms of hypoxia and describe its treatment
Objectives

- List the indications and oxygen delivery concentrations of the following:
  - Nasal cannula
  - Simple face mask
  - Nonrebreather mask
  - Venturi mask
- Recall the indications, contraindications, and alternatives to endotracheal intubation

Objectives

- Assemble and check the equipment used to perform endotracheal intubation
- List and demonstrate the steps for performing endotracheal intubation
- Demonstrate the methods used to ensure correct placement of the endotracheal tube

Introduction

- EMT-I must be prepared to treat:
  - Obstructed airway
  - Aspiration
  - Inadequate ventilation
  - Hypoxia
Introduction

- Procedures employed
  - Manual
  - Adjunctive equipment
  - Advanced techniques

Introduction

- Most important components of training
  - Maintain a patent airway
  - Ventilatory assistance
  - Oxygenation

Anatomy of the Respiratory System

- Job of the respiratory system

- Normal breathing
  - Patent airway
  - Intact system
  - Unobstructed passageways
  - Adequate blood flow
  - Neurologic stimulation
Anatomy of the Respiratory System

- **Nose**
  - Uppermost aspect
  - Bony and cartilaginous
  - Surrounded by the maxilla
  - Nostrils/nares
  - Nasal septum
  - Turbinates
  - Rich blood supply

- **Mouth**
  - Oral cavity
  - Cheeks, hard and soft palates, tongue
  - Lips
  - Gums and teeth
  - Mandible
  - Hyoid bone

- **Pharynx**
  - Throat
  - Three regions
    - Nasopharynx
    - Oropharynx
    - Laryngopharynx
  - Gag reflex
  - Epiglottis
Anatomy of the Respiratory System

- Larynx
  - Adam's apple
  - Protects airway
  - Produces voice
  - Cricoid cartilage
  - False vocal cord
  - True vocal cord

Vocal cords

Lower airway, Trachea
Anatomy of the Respiratory System

Physiology of the Respiratory System

- Respiration
  - External
  - Internal
  - Cellular

Physiology of the Respiratory System

Inspiration
Expiration

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Physiology of the Respiratory System

- Ventilation
  - Mechanisms of inspiration

- Respiratory volume
  - Average adult
    - 500-800 cc
    - 12-20/min
    - Respiratory cycle = tidal volume
    - Minute volume
    - Removes carbon dioxide; brings in oxygen
Physiology of the Respiratory System

Partial pressure of various gases in atmospheric air

Physiology of the Respiratory System

Diffusion of oxygen and carbon dioxide

Physiology of the Respiratory System

Comparison of oxygen release at rest and during exercise
Physiology of the Respiratory System

Transportation of carbon dioxide

Physiology of the Respiratory System

CO₂ levels are inversely proportional to ventilations

Physiology of the Respiratory System

Respiratory centers act as a unit to control respiration

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Physiology of the Respiratory System

The respiratory mechanism that affects depth and rate of ventilation

Assessment of the Patient

- Essential elements
  - Open airway
  - Spinal injury
  - Respiratory effectiveness
  - Circulatory effectiveness

- Initial impression
  - Patient responsive
  - Patient breathing
  - Adequate air exchange
Assessment of the Patient

- Initial impression
  - Patient responsive
  - Restlessness
  - Agitation
  - Disorientation
  - Coma

Assessment of the Patient

- Initial impression
  - Respiratory function
    - Airway patency
    - Neck appearance
    - Breathing efforts
    - Skin color
    - Breath sounds

Assessment of the Patient

- Initial impression
  - Respiratory function
    - Outward signs
      - Flaring nares, accessory muscle use
    - Air movement
    - Compliance
    - Pulse rate
    - Silence
  - Pulse oximetry
Assessment of the Patient

<table>
<thead>
<tr>
<th>SOUND</th>
<th>COMMON TYPES OF AIRWAY OBSTRUCTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Snoring respirations</td>
<td>The tongue</td>
</tr>
<tr>
<td>Gurgling sounds</td>
<td>Accumulation of blood, vomitus, or other secretions</td>
</tr>
<tr>
<td>Stridor</td>
<td>Laryngeal edema or constriction</td>
</tr>
</tbody>
</table>

Assessment of the Patient

- Neck
  - Distended jugular veins
  - Tracheal shift
  - Tugging

Assessment of the Patient

- Breathing efforts
  - Adequacy of air exchange
  - Feel for air exchange
  - Spontaneous and regular

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Assessment of the Patient
- Pulse oximetry
  - Reaffirm hypoxia
  - Reveal hypoxia
  - Determine oxygen adjunct
  - Monitor improvement or deterioration
  - When to place an advanced airway
  - Identify changes

Assessment of the Patient
- Secondary confirmation methods
- End-tidal CO₂ detector
  - Verifies correct tube placement
  - Two types
  - Potential weaknesses

Assessment of the Patient
- Esophageal intubation detectors
  - Two types
  - Benefits
Assessment of the Patient

- Chest appearance
  - Intercostal retraction
  - Accessory muscle usage
  - Nasal flaring
  - Tracheal tugging

- Breath sounds
- Epigastric sounds
- Gastric distension
- Skin
- Circulatory status
- History

Upper Airway Problems

- Tongue
- Foreign bodies
- Vomitus
- Blood
- Teeth
- Swelling
- Epiglottis
Upper Airway Problems

- Tongue
  - Most common cause

Upper Airway Problems

- Manual manipulations
  - Head-tilt/chin-lift
  - Jaw-thrust
  - Jaw-lift
  - Caution when trauma is suspected
  - However, airway is always the first priority

Upper Airway Problems

- Head-tilt/chin-lift
  - Preferred procedure
Upper Airway Problems

- Jaw-lift
  - Fingers into patient’s mouth required
  - Use caution

Upper Airway Problems

- Chin-lift or jaw-thrust without head-tilt
  - Suspected spine injury

Upper Airway Problems

- Oropharyngeal airways
  - Several sizes
  - Proper size must be used
Upper Airway Problems

- Oropharyngeal airways
  - Indications
    - Maintain open airway
    - Bite block
  - Advantages
    - Inserted quickly
    - Counters obstructions
    - Facilitates suctioning
  - Disadvantages
    - Does not isolate trachea
    - Teeth clenched
    - Can obstruct airway
    - Easily dislodged
  - Contraindications
    - Gag reflex
    - Severe maxillofacial injuries

Oropharyngeal Airway

- Measure airway to size
- Insert airway with tip toward roof of mouth
- Slide along roof of mouth
Oropharyngeal Airway

- Rotate 180°
- Flange rested on patient’s lips
- Ventilate 100% O₂ through bag mask

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Oropharyngeal Airway

- Precautions
  - Ensure airway correctly positioned

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Upper Airway Problems

- Nasopharyngeal airways
  - Indications
  - Advantages
  - Disadvantages
  - Contraindications
  - Precautions
Nasopharyngeal Airways

Upper Airway Problems

- Foreign bodies
  - Stridor
  - Cyanosis
  - Tracheal tugging

- Aspiration
  - Regurgitation
  - Hypercarbia
Upper Airway Problems

- Cricoid pressure

Upper Airway Problems—
Suction Units

Upper Airway Problems—
Suction Catheters

- Tonsil tip
  - Disadvantages
    - Limited to upper airway
    - Can cause injuries

- Whistle tip
  - Disadvantages
    - Removing large volumes
    - Small food particles

Disadvantages

- Limited to upper airway
- Can cause injuries

- Removing large volumes
- Small food particles
Upper Airway Problems

- Suctioning precautions
  - Restricted to ≤15 sec
  - Do not activate suction during insertion

Upper Airway Problems

- Suctioning hazards
  - Cardiac dysrhythmias
  - Hypertension/tachycardia
  - Hypotension/bradycardia
  - Increased intracranial pressure and decreased cerebral blood flow

Upper Airway Problems—Suction Procedure

- Employ isolation precautions
- Ventilate prior to suctioning
- Determine depth
Upper Airway Problems—Suction Procedure

- Insert catheter

- Turn unit on
  - 15 sec

- Withdraw catheter

- Flush catheter

- Ventilate patient

Upper Airway Problems—Suction Procedure

- Ventilatory problems
  - Hypoventilation
    - Reduced rate or depth of breathing
  - Hypoxia
    - Reduced oxygen supply to cells

Ventilatory problems

- Hypoventilation
  - Reduced rate or depth of breathing
- Hypoxia
  - Reduced oxygen supply to cells
Causes of Hypoventilation
- Depressed respiratory function
- Drug overdose
- Spinal injury
- Head injury
- Impaired ventilatory function
- Fractured ribs
- Flail chest
- Pneumothorax
- COPD
- Muscular paralysis
- Poliomyelitis

Ventilatory Problems
- Basic treatment
  - Assisted breathing challenges
    - Difficulty maintaining open airway
    - Resistance to airflow
    - Need to maintain closed ventilatory system

Upper Airway Problems
- Procedures and devices
  - Mouth-to-mouth/nose breathing
  - Mouth-to-mask breathing
  - Bag-mask device
  - Demand valve resuscitator
  - Automatic ventilator
Upper Airway Problems
- Procedures and devices
  - Mouth-to-mouth/nose breathing
    - Quick and effective
    - Requires no adjunctive equipment
    - EMT-I should employ protective barrier
    - Patient may have secretions or transmittable disease
    - Provides little oxygen

Upper Airway Problems
- Procedures and devices
  - Pocket mask
    - More effective than bag mask
    - One-way valve available
    - Supplemental oxygen available

Upper Airway Problems—Pocket Mask Procedure
- Employ isolation precautions
- Connect $O_2$
- Adjust flow rate
- Attach one-way valve
Upper Airway Problems—Pocket Mask Procedure

- Open airway
- Insert oropharyngeal airway
- Place mask on patient
- Position hands over mask
- Hook fingers under jaw
- Ventilate patient
- Check ventilatory effectiveness
- Allow patient to exhale

Upper Airway Problems—Bag Mask

- Available in three sizes
  - Adult—1000-1600 mL
  - Child—500-700 mL
  - Infant—150-240 mL
- May be used with:
  - Mask
  - Endotracheal tube
  - Combitube
  - LMA

Upper Airway Problems—Bag Mask

- Advantages
  - Immediate means of ventilatory support
  - Conveys sense of compliance
  - Used with spontaneously breathing patient
  - Delivers oxygen-enriched mixture
- Disadvantages
  - Hard to maintain adequate seal
  - Difficult to deliver required tidal volume
Upper Airway Problems—Bag Mask

- Precautions
  - Cumbersome and difficult to use
  - Provide adequate ventilatory volumes
  - Squeeze bag completely
  - Increased resistance suggests airway obstruction

Upper Airway Problems—Bag-Mask Procedure

- Body substance precautions
- Tilt head back
- Insert airway
- Place mask on face
- Obtain tight seal
- Hook fingers under jaw
- Squeeze bag
- Watch for chest rise and fall
- Auscultate chest

Bag-Mask Procedure—2 EMT-Is
Upper Airway Problems—Demand Valve Resuscitator

- Manually triggered, oxygen powered
- Small, easy to use, rugged
- Connected to high-pressure tubing
- Can be attached to:
  - Face mask
  - Advanced airway
    - Use with extreme caution

Advantages

- Easy to use
- High oxygen concentrations

Disadvantages

- Fails to provide chest compliance
- May cause barotrauma
- May open esophagus
- Quickly expends oxygen cylinders

Precautions

- Dependent on oxygen source
- Pediatric patients
- Endotracheally intubated patients

Upper Airway Problems—Demand Valve Resuscitator Procedure

- Take body substance precautions
- Tilt head back
- Insert airway
- Open valve
- Select proper size mask
Upper Airway Problems—Demand Valve Resuscitator Procedure

- Place mask on face
- With both hands make a seal
- Deliver ventilation
- Watch for chest rise and fall
- Auscultate lung sounds
- Release pressure to allow expiration

Upper Airway Problems

- Hypoxia
  - Causes
    - Insufficient oxygen in inspired air
    - Failure of the ventilatory mechanism
    - Upper airway compromise
    - Lower airway compromise
    - Circulatory deficiency
    - Cellular deficiency

Upper Airway Problems

- Hypoxia
  - Treatment
    - Directed at increasing patient’s oxygen level
      - Percent of oxygen to patient
      - Alveolar level
      - Arterial level
      - Delivered to cells
Upper Airway Problems

- Nasal cannula
  - Minor to moderate hypoxia
  - Carbon dioxide retention
  - Feels suffocated
  - Feels nauseous

- Simple face mask
  - Moderate hypoxia
  - May feel restrictive
  - Hot and confining
  - Difficult to hear patient
  - Requires tight face seal

- Nonrebreather mask
  - Severely hypoxic patients
    - Respiratory compromise
    - Shock
    - AMI
    - Trauma
    - Carbon monoxide poisoning
Upper Airway Problems

- Venturi mask
  - COPD patients
  - Careful control needed
  - Oxygen concentrations:
    - 24%, 28%, 35%, 40%

Pharyngotracheal Airways—Esophageal Tracheal Combitube

- Advantages
  - Rapid and easy to insert
  - Inserted without visualization; head in neutral position
  - Patient can be ventilated regardless of placement
  - Self-adjusting, self-positioning posterior pharyngeal balloon
  - No need to maintain seal
  - Can protect trachea
  - Significantly reduces distension and regurgitation; immediate gastric suctioning possible

- Disadvantages
  - Trachea cannot be suctioned
  - Only used in unconscious adults
  - Difficult to intubate around

- Contraindications
  - Gag reflex
  - <4 ft tall
  - Caustic substances
  - Esophageal disease
Esophageal Tracheal Combitube

- Equipment
  - Combitube kit with syringes
  - Water-soluble lubricant
  - Suctioning unit
  - Bag-valve-device or demand valve
  - Gloves
  - Eye protection

Procedure
- Perform BSI precautions
- Manually open airway
- Ventilate with 100% O₂
- Assign another EMT-I to take over ventilations from side of patient’s head
Esophageal Tracheal Combitube

Procedure
- Assemble and check equipment
  - Connect blue-tipped syringe to blue tube marked No. 1
  - Connect white-tipped syringe to white tube marked No. 2

Esophageal Tracheal Combitube

Procedure
- Lubricate tube

Esophageal Tracheal Combitube

Procedure
- Place head in neutral position
- Insert your thumb deep into patient’s mouth grasping tongue and lower jaw
- Lift tongue and lower jaw anteriorly
- Hold Combitube so it curves in same direction as natural curvature of pharynx
- Guide Combitube along base of tongue
Esophageal Tracheal Combitube

- Procedure
  - Continue inserting until teeth are between heavy black lines

Esophageal Tracheal Combitube

- Procedure
  - Inflate blue pilot balloon

Esophageal Tracheal Combitube

- Procedure
  - Inflate white pilot balloon
Esophageal Tracheal Combitube

- Procedure
  - Begin ventilating through blue tube
  - Look for chest rise; auscultate for epigastric and chest sounds

- Procedure
  - If no chest rise, switch over to ventilating through clear tube (No. 2)
  - Continue ventilations

Laryngeal Mask Airway (LMA)

- Advantages
  - Training is simple
  - Do not need to visualize airway

- Disadvantages
  - Some patients cannot be ventilated through LMA
  - Does not isolate trachea
  - Do not use if intact gag reflex or semiconscious
Laryngeal Mask Airway (LMA)

- Procedure
  - Perform BSI precautions
  - Manually open airway
  - Ventilate the patient with 100% O₂
  - Assign another EMT-I to take over ventilations from side of patient’s head
  - Check for leaks; fully deflate mask
  - Lubricate back of mask

- Procedure
  - Pull lower jaw downward so mask does not fold over oral cavity
  - Extend head and flex neck
  - Place extreme tip of mask against inner surface of upper incisor teeth or gums; align black line with middle of nose

- Procedure
  - Verify position of mask
  - Press mask tip against hard palate to flatten, simultaneously advance into oral cavity, pharynx, and rest against upper esophageal sphincter
  - Inflate cuff
**Laryngeal Mask Airway (LMA)**
- Procedure
  - Ventilate while holding LMA in place
  - Confirm placement
  - Insert bite block
  - Secure LMA in place
  - Continue ventilations

**Endotracheal Intubation**
- Only performed by trained and proficient EMT-I

**Endotracheal Intubation**
- Indications
  - Unable to ventilate with conventional methods
  - Patient cannot protect airway
  - Prolonged ventilation needed
  - Experiencing upper airway compromise
  - Unresponsive patient with gag reflex
  - Decreased tidal volume
  - Airway obstruction
Endotracheal Intubation

- Advantages
  - Reduces risk of aspirating
  - Facilitates ventilation and oxygenation
  - Prevents gastric insufflation
  - Allows suctioning trachea and bronchi
  - Can be used to deliver medications, although IV/IO is preferred

- Disadvantages
  - Complicated skill requiring extensive training
  - Requires specialized equipment
  - Vocal cords must be visualized

- Precautions
  - Must continually reassess tube placement

- Contraindications
  - Patients with epiglottitis

- Routes
  - Orotracheal
  - Nasotracheal
  - Digitally via orotracheal route
Endotracheal Intubation

- Laryngoscope
  - Moves tongue and epiglottis out of way
  - Handle and blade
  - Light

Variety of sizes
Two types
- Macintosh (curved)
- Miller, Wisconsin, or Flagg (straight)
- User preference

Endotracheal tube
Endotracheal Intubation

- Laryngoscope
  - Handle, blades, etc.
- Endotracheal tubes
- 10 mL syringe
- Stylet
- Magill forceps
- Tie-down tape

Endotracheal Intubation

- Check distal cuff of ET tube

Endotracheal Intubation

- Insert blade
- Displace tongue to left
Endotracheal Intubation

- Move blade toward midline
- Advance until distal end at base of tongue
Endotracheal Intubation

- Epiglottis

Endotracheal Intubation

- Advance ET tube into larynx

Endotracheal Intubation

- Advance ET tube through glottic opening
Endotracheal Intubation

- ET tube passing through glottic opening

Endotracheal Intubation

- Inflate cuff
- Ventilate patient

Endotracheal Intubation

- Complications
  - Hypoxia
  - Injury to teeth and tissue
  - Misplacement of tube
Endotracheal Intubation
- Misplaced tube
- Characteristic bulge

Endotracheal Intubation
- Misplacement into right mainstem bronchus

Endotracheal Intubation
- Misplacement into esophagus
Endotracheal Intubation

- Digital intubation

Endotracheal Intubation

- Transillumination method

Video for Orotracheal Intubation
Summary
- Airway management is critical element of prehospital care
- Ongoing practice is necessary to maintain skills
- Respiratory system's primary function must be maintained
- Airway must be patent
- Must be adequate supplies of oxygen in inspired air

Summary
- Respiratory minute volumes must be sufficient to remove carbon dioxide
- Airway must first be secured
- Use basic maneuvers such as head-tilt/chin-lift to move tongue and epiglottis away from obstructing positions
- Use chin-lift without head-tilt in suspected spinal injury

Summary
- Variety of procedures/devices can support patient's breathing, including bag mask
- Frequent practice in use of bag mask necessary for proficiency
- Inspired oxygen concentrations can be increased with variety of devices, including nonrebreather mask
- ET intubation is preferred technique for securing airway
Summary

- Accidental misplacement of ET tube can result in severe hypoxia and death
- When performing endotracheal intubation, care must be taken to avoid injury to teeth and airway tissues
- Orotracheal intubation is most common route

Questions?