Objectives

1. Define key terms introduced in this chapter.
2. Distinguish between the terms respiration, ventilation, pulmonary ventilation, external respiration, internal respiration, and cellular ventilation (slides 17-18).
3. Relate the anatomy and physiology of the respiratory system to ventilation and respiration (slides 19-38).
4. Recognize signs of mild to moderate and severe hypoxia (slides 31-34).
5. Explain differences between adults and children in the signs of hypoxia.
6. Describe the relationship between airway status and mental status (slides 34, 45).
7. Give examples of conditions that can lead to impaired ventilation and respiration (slides 39-40).
8. Describe how partial or complete obstruction of the airway leads to hypoxia (slides 39-40, 44-45).
9. Describe differences between adults and children in the anatomy and physiology of the respiratory system (slides 41-42).
10. Explain the causes of each of the following abnormal upper airway sounds (slides 46-47).
   a. Snoring
   b. Crowing
   c. Gurgling
   d. Stridor
Objectives

11. Demonstrate each of the following procedures necessary for airway assessment and correction (slides 48-59):
   a. Opening the mouth of an unresponsive patient
   b. Suctioning the mouth
   c. Head tilt, chin lift maneuver
   d. Jaw-thrust maneuver
   e. Insertion of an oropharyngeal airway
   f. Insertion of a nasopharyngeal airway
   g. Positioning a patient for control of the airway

12. Describe the performance requirements for fixed suction devices (slide 62).

Objectives

13. Compare the function of fixed and portable suction devices (slide 63).
14. Compare the use of rigid and soft suction catheters (slide 65).
15. Explain special considerations to be kept in mind when suctioning patients, including signs of hypoxia and patients with copious amounts of vomit that cannot be quickly suctioned (slides 66-67).

Objectives

17. Distinguish between patients with adequate and inadequate breathing by considering the following (slides 74-85):
   a. Minute ventilation
   b. Alveolar ventilation
   c. Inspection of the chest
   d. Patient’s general appearance
   e. Regularity of breathing
   f. Flaring of the nostrils
   g. Patient’s ability to speak
   h. Airflow
   i. Breath sounds
### Objectives

18. Identify patients with indications for supplemental oxygen and positive pressure ventilation (slides 82-90, 159-160).

19. Describe the physiological differences between spontaneous and positive pressure ventilation (slides 91-92).

20. Distinguish between adequate and inadequate positive pressure ventilation (slides 97-100).

21. Demonstrate each of the following procedures for artificial ventilation (slides 94, 103-104, 110-117, 132):
   a. Mouth-to-mouth and mouth-to-mask ventilation
   b. Delivery of positive pressure ventilations with a bag-valve-mask device (one-person and two-person), with a flow-restricted oxygen powered ventilation device, and with an automatic transport ventilator

22. Differentiate between the duration and volume of ventilation for patients with and without pulses (slides 105-107).

23. Explain the significance of avoiding gastric inflation when administering positive pressure ventilation (slides 101-102, 108-109).

24. Describe indications and methods for administering positive pressure ventilations to a patient who is breathing spontaneously (slides 118-119).

25. Discuss the indications, contraindications, and methods for administering continuous positive airway pressure (CPAP) or bilevel positive airway pressure (BiPAP) (slides 120-129).

26. Discuss the hazards of overventilation (slides 130-131).

27. Discuss special considerations of airway management and ventilation for the following (slides 133-147):
   a. Patients with stomas or tracheostomy tubes
   b. Infants and children
   c. Patients with facial injuries
   d. Patients with foreign body airway obstructions
   e. Patients with dental appliances

28. Describe the properties of oxygen.

29. Differentiate between the various sizes of oxygen cylinders available (slide 150).
Objectives

30. Describe the hazards associated with oxygen use and safety precautions to be observed when using oxygen or handling oxygen cylinders (slides 153-154, 161-162).

31. Describe the regulation of oxygen pressures, including the uses of high-pressure and therapy regulators (slides 155-156).

32. Discuss the use of oxygen humidifiers (slides 157-158).

33. Discuss the administration of oxygen by nonrebreather mask, nasal cannula, simple face mask, partial rebreather mask, Ventury mask, and tracheostomy mask (slides 163-175).

Multimedia Directory

Slide 72 OPA, NPA, and Suction Techniques Video
Slide 73 OPA Insertion Video
Slide 132 Two-Person BMV Technique
Slide 175 Oxygen Delivery Devices Video
Slide 176 Pulse Oximetry Video

Topics

- Respiration
- Respiratory System Review
- Airway Assessment
- Assessment of Breathing
- Assess for Adequate Breathing
- Making the Decision to Ventilate or Not
- Techniques of Artificial Ventilation
- Special Considerations of Airway Management and Ventilation
- Oxygen Therapy
CASE STUDY

Dispatch

EMS Unit 112

Respond to the Twilight Bar, 59 South Market Street for an unresponsive male.

Time out 1703

Upon Arrival

- Dispatch reports that patient has reportedly been drinking heavily this afternoon
- Found unresponsive by another patron in the bathroom
- 30-year-old male on floor; vomitus on patient's face
How would you proceed to assess and care for this patient?

Respiration

- External respiration
- Internal respiration
Anatomy of the Respiratory System

The Lower Airway

Lower Airway

Thoracic wall

Trachea

Parietal pleura

Visceral pleura

Bronchus

Lungs

Mediastinum

Diaphragm

Lower Airway
Mechanics of Ventilation (Pulmonary Ventilation) Review

**Inhalation**

- Diaphragm
- Intercostal muscles

**Exhalation**
Mechanics of Ventilation (Pulmonary Ventilation) Review

Control of Respiration

- Nervous system
- Chemoreceptors
Respiratory Physiology Review

Hypoxia

Inadequate amount of oxygen to cells

Signs of Mild to Moderate Hypoxia

- Tachypnea
- Dyspnea
- Pale, cool, clammy skin
- Tachycardia
- Restlessness and agitation
- Disorientation and confusion
Severe Hypoxia

- Tachypnea
- Dyspnea
- Cyanosis
- Tachycardia
- Confusion
- Head bobbing
- Slow reaction time
- Altered mental status

Respiratory Physiology Review

Alveolar/Capillary Exchange
(External Respiration)
Causes of Disruption

- Mechanical
- Diseases
- Obstructions

Airway Anatomy in Infants and Children

Back to Objectives
Airway Assessment

Airway Functions and Considerations

• General functions
• Mental status changes
Abnormal Upper Airway Sounds

- Snoring
- Crowing
- Gurgling
- Stridor

Opening the Mouth
Opening the Airway

Head-Tilt, Chin-Lift Maneuver

- No suspected spine injury
- Temporary maneuver
Opening the Airway

Head-Tilt, Chin-Lift in Infants and Children

- Place in neutral position
- Consider pad under shoulders
- Don’t hyperextend

Opening the Airway

Jaw-Thrust Maneuver
• For suspected spine injured patients
• Displacing mandible forward pulls tongue forward

Opening the Airway

Jaw-Thrust Maneuver in Infants and Children
Opening the Airway

Positioning the Patient for Airway Control

- Recovery position
- For patients with no suspected spine injury

Suctioning

Standard Precautions During Suctioning
Necessary to remove obstructions in the patient’s airway
Need protective eyewear, mask, and gloves

Suctioning

Suction Equipment

- Fixed
- Portable
- Suction catheters
Suctioning

Technique of Suctioning

Special Considerations When Suctioning
• Suction for no longer than 15 seconds at a time
• Monitor for decrease in pulse or heart rate; stop suctioning and begin ventilation

Airway Adjuncts

Oropharyngeal (Oral) Airway

• Holds the tongue away from the back of the airway
• Use for patients with NO gag reflex
Airway Adjuncts

Nasopharyngeal (Nasal) Airway

- For use with patients who cannot tolerate an OPA
- Measure carefully
- May still cause gagging

Click here to view a video on OPA, NPA, and suction techniques.

OPA, NPA, and Suction Techniques
Click here to view a video on the topic of OPA insertion.

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Assessment of Breathing

Minute Volume

Back to Objectives
Relationship of Tidal Volume and Respiratory Rate in Assessment of Breathing

Alveolar Ventilation

MV = Volume × Rate

Example:
MV = 200 mL × 12 per minute
MV = 2,400 mL per minute

Remember 150 mL will fill the dead space. The rest will be available for gas exchange.
Assessing for Adequate Breathing

- Look
- Listen
- Feel
- Auscultate

Adequate Breathing
Inadequate Breathing

- Results
- Causes
Inadequate Breathing

Signs of Inadequate Breathing

- Rate
- Rhythm
- Quality
- Depth

Making the Decision to Ventilate or Not
Adequate Respiratory Rate + Adequate Tidal Volume = Adequate Breathing

Any change in this causes inadequate breathing.

Inadequate breathing needs ventilation.

Techniques of Artificial Ventilation

Back to Topics

Positive Pressure Ventilation (PPV)
Differences between Normal Spontaneous Ventilation and Positive Pressure Ventilation

Basic Considerations

- Air movement
- Airway wall pressure
- Esophageal opening pressure
- Cardiac output
Methods of Artificial Ventilation

- Mouth-to-mask
- Bag-valve mask (BVM)
  - One- and two-person method
- Flow-restricted, oxygen-powered ventilation device

Basic Considerations

Standard Precautions
Basic Considerations

**Adequate Ventilation**

- Rate is sufficient
- Tidal volume consistent
- Heart rate returns to normal
- Color improves

**Indications of Adequate Ventilation**

Basic Considerations

**Inadequate Ventilation**
Indications of Inadequate Ventilation

- Ventilation is too fast or too slow
- Chest does not rise and fall
- Heart rate does not return to normal
- Color does not improve

Basic Considerations

Cricoid Pressure

- Sellick maneuver
- Reduces gastric inflation, regurgitation, and aspiration
- Technique
Mouth-to-Mouth Ventilation

- Risk of contracting infectious diseases makes this technique too dangerous for regular use
- The EMT forms a seal with the patient’s mouth or nose
- Limited in its inability to deliver high concentrations of oxygen and risk of body fluid exposure to EMT
When a pulse is present...

- Enough to make the chest rise
- 10 – 12 breaths per minute for adult
- 12 – 20 breaths per minute for pediatric
- 40 – 60 breaths per minute for a newborn

If the patient is pulseless...

- Done in conjunction with CPR
- 30 compressions to two ventilations for adult
- 15 compressions to two ventilations for infant and child with two rescuers

Mouth-to-Mask and Bag-Valve Ventilation: General Considerations

Gastric Inflation
• Decreasing ventilation volume reduces incidence of distention
• Complications

Mouth-to-Mask Ventilation

• Advantages
• Disadvantages
Bag-Valve-Mask Ventilation

Flow-Restricted, Oxygen-Powered Ventilation Device (FROPVD)

• Advantages
• Disadvantages
Automatic Transport Ventilator (ATV)
Ventilation of the Patient Who Is Breathing Spontaneously

Back to Objectives

• Need recognition
• Complications
• Types of patients

Continuous Positive Airway Pressure (CPAP)

Back to Objectives
Continuous Positive Airway Pressure (CPAP)

Indications for CPAP

- Awake and alert enough to follow commands
- Able to maintain his own airway
- Able to breathe on his own
Continuous Positive Airway Pressure (CPAP)

Contraindications for CPAP

- Apnea
- Inability to follow commands
- Unresponsiveness
- Responsiveness only to verbal or painful stimuli
- Cardiac arrest

Continuous Positive Airway Pressure (CPAP)

Administering CPAP
• Inform patient about process
• Continuously coach patient
• May take five to ten minutes to show improvement

Continuous Positive Airway Pressure (CPAP)

BiPAP

• Different pressures for inspiration and expiration
• Not adequately studied prehospital
• Not recommended
Hazards of Overventilation

- Can lead to serious complications
- More ventilation is not good for the patient
- GOOD ventilations are good for the patient

Two-Person BVM Technique

Click here to view a video on two-person BVM technique.
Special Considerations of Airway Management and Ventilation

A Patient with a Stoma or Tracheostomy Tube

- Stoma
- Tracheostomy tube
- Laryngectomy
A Patient with a Stoma or Tracheostomy Tube

Bag-Valve-Masks-To-Tracheostomy-Tube Ventilation

Can still be ventilated through mouth and nose with a mask if unable to be ventilated through tracheostomy

A Patient with a Stoma or Tracheostomy Tube

Mouth-to-Stoma Ventilation
Infants and Children

- Maintain neutral head alignment
- Avoid excessive pressures
- Use airway adjuncts
- Ventilate at proper rate

- Not recommended due to potential exposure to infectious disease
- Use a barrier device if no BVM present
Patients with Facial Injuries

- May be necessary to use an OPA and BVM
- Frequent or constant suctioning may be necessary

Foreign Body Airway Obstruction
Effectively moving air
Breathing weak and ineffective

Dental Appliances

• If they are secure, leave in place
• If loose, remove them
• Reassess the mouth frequently
Oxygen Therapy

Oxygen Cylinders

- All are the same pressure, 2,000 psi
- D, E, M, G, H cylinder capacity
Oxygen Cylinders

Duration of Flow

The higher the flow rate, the faster the oxygen is depleted from the tank.

Safety Precautions
• No grease or oil in fittings
• No smoking near tanks
• Store cylinders below 125°F
• Use proper valve
• Prevent from toppling over

Pressure Regulators

• High-pressure regulator
• Therapy regulator
Oxygen Humidifiers

• Generally not needed for prehospital
• Good for long-term oxygen delivery

Indications for Oxygen Use
Indications
If in doubt, administer it

Hazards of Oxygen Administration

Possible hazards
Possible respiratory effects
Oxygen Administration Procedures

• Check cylinder
• Dust out valve assembly
• Attach regulator
• Charge regulator; check amount of O₂
• Attach mask or cannula
• Open flowmeter; set flow rate
• Attach to patient

Terminating Oxygen Therapy
• Remove mask from patient
• Turn off regulator
• Turn off cylinder
• Drain regulator of O₂

Transferring the Oxygen Source: Portable to On-Board

• Remove O₂ from patient’s face prior to transfer
• After transfer, reapply
Oxygen Delivery Equipment

Nonrebreather Mask

Delivered concentration approximately 90% oxygen

Ambient air sealed out

100% oxygen

Oxygen Delivery Equipment

Nasal Cannula
Oxygen Delivery Equipment

Other Oxygen Delivery Devices

- Simple face mask
- Partial rebreather mask
- Venturi mask
- Tracheostomy mask
Oxygen Delivery Devices

Click here to view a video on the topic of oxygen delivery devices.

Return to Directory

Pulse Oximetry

Click here to view a video on the topic of pulse oximetry.

Return to Directory

CASE STUDY

Follow-Up
Scene Size-up

- Bartender reports that patient has been drinking "all morning and afternoon"
- 30-year-old male lying in puddle of vomit
- No one knows his name or has seen him before

Patient Assessment

- In-line stabilization; place patient on backboard
- No gag reflex
- RR: six per minute; ventilations at ten per minute

Patient Assessment

- No signs of head or neck trauma
- En route patient vomits and is suctioned
- Transfer patient to ED staff
Critical Thinking Scenario

- 67-year-old male; sudden onset of an extremely severe headache, then became confused and started losing consciousness
- Family laid him on the couch to prevent further injury
- Patient is lying supine on the couch, not alert
- Snoring respirations

Critical Thinking Scenario

- Exhibits flexion posturing when you apply a trapezius pinch

Vital signs:
- HR: 50 bpm; radial pulse is strong
- RR: five to six per minute; chest moving minimally with each breath
- Skin is normal color, warm, and dry
- SpO₂ is 79 percent

Critical Thinking Questions

1. What is the status of the patient’s airway?
2. How would you manage the airway in this particular patient?
3. What is the status of his ventilation?
4. What emergency care would you provide to manage the ventilation?
Critical Thinking Questions

5. What is the oxygenation status of the patient?
6. What intervention would you provide to manage the oxygenation status?

Reinforce and Review

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