

Module 3:

Airway

OBJECTIVES

At the completion of this lesson, the student will be able

COGNITIVE OBJECTIVES

- 2-1 Name and label the major structures of the respiratory system on a diagram.
- 2-2 List the signs of adequate breathing.
- 2-3 List the signs of inadequate breathing.
- 2-4 Describe the steps in performing the head-tilt chin-lift.
- 2-5 Describe the steps in performing the jaw thrust.
- 2-6 Describe the techniques of suctioning.
- 2-7 Describe how to measure and insert an oropharyngeal (oral) airway.
- 2-8 Describe how to measure and insert a nasopharyngeal (nasal) airway.
- 2-9 Describe the steps in performing the skill of artificially ventilating a patient with a bag-valve-mask for one and two rescuers.
- 2-10 Describe how to artificially ventilate a patient with a pocket mask.
- 2-11 Describe the steps in artificially ventilating a patient with a flow restricted, oxygen-powered ventilation device.
- 2-12 Identify a non-rebreather face mask and state the oxygen flow requirements needed for its use.
- 2-13 Identify a nasal cannula and state the flow requirements needed for its use.

AFFECTIVE OBJECTIVES

- 2-14 Explain the rationale for basic life support artificial ventilation and airway protection skills taking priority over most other life support skills.
- 2-15 Explain the rationale for providing oxygenation through high inspired oxygen concentrations to patients who, in the past, may have received low concentrations.

PSYCHOMOTOR OBJECTIVES

- 2-16 Demonstrate the steps in performing the skill of artificially ventilating a patient with a bag-valve-mask for one and two rescuers.
- 2-17 Demonstrate how to insert an oropharyngeal and nasopharyngeal airway.
- 2-18 Demonstrate the use of a non-rebreather face mask and a nasal cannula.
- 2-19 Demonstrate artificial ventilation of a patient with a flow restricted, oxygen powered ventilation device.
- 2-20 Demonstrate the techniques of suctioning.

PREPARATION

Motivation: The most critical intervention an EMT can provide for a patient is airway management and ventilatory support. A patient without an airway is a dead patient.

MATERIALS

AV Equipment: Utilize various audio-visual materials relating to airway management. The continuous design and development of new audio-visual materials relating to EMS requires careful review to determine which best meet the needs of the program. Materials should be edited to assure the objectives of the curriculum are met.

EMS Equipment: Pocket mask, bag-valve-mask, flow restricted, oxygen-powered ventilation device, oral airways, nasal airways, suction units, suction catheters, oxygen tank, regulator, non-rebreather mask and nasal cannula.

PERSONNEL

Primary Instructor: One EMT-Basic instructor knowledgeable in airway management.

Assistant Instructor: The instructor to Student ratio of 6: 1 for psychomotor skills practice. Individuals used as assistant instructors should be knowledgeable in airway techniques and management.

PRESENTATION

Declarative (What)

1. Anatomy review
 1. Respiratory System
 1. Nose and mouth
 2. Pharynx
 1. Oropharynx
 2. Nasopharynx
 3. Epiglottis - a leaf-shaped structure that prevents food and liquid from entering the trachea during swallowing.
 4. Trachea (windpipe)
 5. Cricoid cartilage - firm cartilage ring forming the lower portion of the larynx.
 6. Larynx (voice box)
 7. Bronchi - two major branches of the trachea to the lungs. Bronchus subdivides into Bronchioles, which are the smaller air passages ending at the alveoli.
 8. Alveoli
 9. Lungs
 10. Diaphragm
 1. Inhalation (active)
 - (1) Diaphragm and intercostal muscles contract, increasing the size of the thoracic cavity.
 - (1) Diaphragm moves slightly downward, flares lower portion of rib cage.
 - (2) Ribs move upward/outward.
 - (2) Air flows into the lungs.
 2. Exhalation (passive)
 - (1) Diaphragm and intercostal muscles relax, decreasing the size of the thoracic cavity.
 - (1) Diaphragm moves upward.
 - (2) Ribs move downward/inward.
 - (2) Air flows out of the lungs.
11. Respiratory physiology
 1. Alveolar/capillary exchange
 - (1) Oxygen-rich air enters the alveoli during each inspiration.
 - (2) Oxygen-poor blood in the capillaries passes into the alveoli.
 - (3) Oxygen enters the capillaries as carbon dioxide enters the alveoli.
 2. Capillary/cellular exchange
 - (1) Cells give up carbon dioxide to the capillaries.
 - (2) Capillaries give up oxygen to the cells.
 3. Adequate breathing
 - (1) Normal Rate
 - (1) Adult - 12-20/minute

- (2) Child - 15-30/minute
 - (3) Infant - 25-50/minute
 - (2) Rhythm
 - (1) Regular
 - (2) Irregular
 - (3) Quality
 - (1) Breath sounds - present and equal
 - 1) Free of gurgling, gasping, crowing, and wheezing
 - (4) Chest expansion - adequate and equal
 - (1) Minimum effort of breathing - use of accessory muscles - predominantly in infants and children
 - (5) Depth (tidal volume) -
 - (1) adequate and equal expansion of both sides of chest.
- 4. Inadequate breathing
 - (1) Rate - outside of normal ranges.
 - (2) Rhythm - irregular
 - (3) Quality
 - (1) Breath sounds - diminished or absent
 - (2) Chest expansion - unequal or inadequate
 - (3) Increased effort of breathing - use of accessory muscles - predominantly in infants and children
 - (4) Depth (tidal volume) - inadequate/shallow
 - (5) The skin may be pale or cyanotic (blue) and cool and clammy.
 - (6) There may be retractions above the clavicles, between the ribs and below the rib cage, especially in children.
 - (7) Nasal flaring may be present, especially in children.
 - (8) In infants, there may be "seesaw" breathing where the abdomen and chest move in opposite directions.
 - (9) Agonal respirations (occasional gasping breaths) may be seen just before death.
- 12. Infant and child anatomy considerations
 - 1. Mouth and nose - in general: All structures are smaller and more easily obstructed than in adults.
 - 2. Pharynx - infants' and children's tongues take up proportionally more space in the mouth than adults.
 - 3. Trachea (windpipe)
 - (1) Infants and children have narrower tracheas that are obstructed more easily by swelling.
 - (2) The trachea is softer and more flexible in infants and children.
 - 4. Cricoid cartilage - like other cartilage in the infant and child, the cricoid cartilage is less developed and less rigid.

5. Diaphragm - chest wall is softer, infants and children tend to depend more heavily on the diaphragm for breathing.
2. Adequate and inadequate artificial ventilation
 1. An EMT-Basic is artificially ventilating a patient adequately when:
 1. The chest rises and falls with each artificial ventilation.
 2. The rate is sufficient, approximately 12 per minute for adults and 20 times per minute for children and infants.

NOTE: Heart rate may return to normal with successful artificial ventilation.
 2. Artificial ventilation is inadequate when:
 1. The chest does not rise and fall with artificial ventilation.
 2. The rate is too slow or too fast.

NOTE: Heart rate may not return to normal with artificial ventilation.
2. Opening the Airway
 1. Head-tilt chin-lift when no neck injury suspected-review technique learned in BLS course.
 2. Jaw thrust when the EMT-Basic suspects spinal injury - review technique learned in BLS course.
 3. Assess need for suctioning.
3. Techniques of Suctioning
 1. Body substance isolation
 2. Suction device should be inspected on a regular basis before it is needed. A properly functioning unit with a gauge should generate 300 mmHg vacuum. A battery operated unit should have a charged battery.
 3. Turn on the suction unit.
 4. Attach a catheter.
 1. Use rigid catheter when suctioning mouth of an infant or child.
 2. Often will need to suction nasal passages; should use a bulb suction or French catheter with low to medium suction.
 5. Insert the catheter into the oral cavity without suction, if possible. Insert only to the base of the tongue.
 6. Apply suction.
 1. Move the catheter tip side to side.
 7. Suction for no more than 15 seconds at a time.
 1. In infants and children, shorter suction time should be used.
 2. If the patient has secretions or emesis that cannot be removed quickly and easily by suctioning, the patient should be log rolled and the oropharynx should be cleared.

3. If patient produces frothy secretions as rapidly as suctioning can remove, suction for 15 seconds, artificially ventilate for two minutes, then suction for 15 seconds, and continue in that manner. Consult medical direction for this situation.
8. If necessary, rinse the catheter and tubing with water to prevent obstruction of the tubing from dried material.
4. Techniques of Artificial Ventilation
 1. In order of preference, the methods for ventilating a patient by the EMT-Basic are as follows:
 1. Mouth-to-mask with supplemental oxygen
 2. Two person bag-valve-mask
 3. Flow restricted, oxygen powered ventilation device
 4. One person bag-valve-mask
 1. EMTs must be aware of the difficulty of a single rescuer's maintaining an adequate mask-to-face seal and delivering an adequate inspiratory volume.
 2. Mouth-to-mask
 1. Review technique learned in BLS course.
 2. The mask should be connected to high flow oxygen = 15 liters per minute.
 3. Bag-valve-mask
 1. The bag-valve-mask consists of a self-inflating bag, one way valve, face mask, oxygen reservoir. It needs to be connected to oxygen to perform most effectively.
 2. Bag-valve-mask issues
 1. Volume of approximately 1600 milliliters
 2. Provides less volume than mouth-to-mask
 3. EMT-Basics working alone may have difficulty maintaining an airtight seal.
 4. Two EMT-Basics using the device will be more effective.
 5. Position self at top of patient's head for optimal performance.
 6. Adjunctive airways (oral or nasal) may be necessary in conjunction with bag-valve-mask.
 3. Use when no trauma is suspected
 1. After opening airway, select correct mask size (adult, infant or child).
 2. Position thumbs over top half of mask, index and middle fingers over bottom half.
 3. Place apex of mask over bridge of nose, then lower mask over mouth and upper chin. If mask has large round cuff surrounding a ventilation port, center port over mouth.
 4. Use ring and little fingers to bring jaw up to mask.
 5. Connect bag to mask if not already done.

6. Have assistant squeeze bag with two hands until chest rises.
 7. If alone, form a "C" around the ventilations port with thumb and index finger, use middle, ring and little fingers under jaw to maintain chin lift and complete the seal.
 8. Repeat a minimum of every 5 seconds for adults and every 3 seconds for children and infants.
 9. If chest does not rise and fall, re-evaluate
 - (1) If chest does not rise, reposition head.
 - (2) If air is escaping from under the mask, reposition fingers and mask.
 - (3) Check for obstruction.
 - (4) If chest still does not rise and fall, use alternative method of artificial ventilation, e.g., pocket mask, manually triggered device.
 10. If necessary, consider use of adjuncts.
 - (1) Oral airway
 - (2) Nasal airway
4. Use with suspected trauma
1. After opening airway, select correct mask size (adult, infant or child).
 2. Immobilize head and neck, e.g., have an assistant hold head manually or use your knees to prevent movement.
 3. Place appropriate sized airway adjunct.
 4. Position thumbs over top half of mask, index and middle fingers over bottom half.
 5. Place apex of mask over bridge of nose, then lower mask over mouth and upper chin. If mask has large round cuff surrounding a ventilation port, center port over mouth.
 6. Use ring and little fingers to bring jaw up to mask without tilting head or neck.
 7. Connect bag to mask if not already done.
 8. Have assistant squeeze bag with two hands until chest rises.
 9. Repeat every 5 seconds for adults and every 3 seconds for children and infants, continuing to hold jaw up without moving head or neck.
 10. If chest does not rise, re-evaluate:
 - (1) If abdomen rises, reposition jaw.
 - (2) If air is escaping from under the mask, reposition fingers and mask.
 - (3) Check for obstruction.
 - (4) If chest still does not rise, use alternative method of artificial ventilation, e.g., pocket mask.
 11. If necessary, consider use of adjuncts.
 - (1) Oral airway
 - (2) Nasal airway

4. Flow restricted, oxygen-powered ventilation devices (manually triggered positive pressure device)
 1. Flow restricted, oxygen-powered ventilation devices (for use in adults only) should provide
 1. A peak flow rate of 100% oxygen at up to 40 LPM.
 2. An inspiratory pressure relief valve that opens at approximately 60 centimeters water and vents any remaining volume to the atmosphere or ceases gas flow.
 3. An audible alarm that sounds whenever the relief valve pressure is exceeded.
 4. Satisfactory operation under ordinary environmental conditions and extremes of temperature.
 5. A trigger positioned so that both hands of the EMT-Basic can remain on the mask to hold it in position.
 2. Use when no neck injury is suspected
 1. After opening airway, insert correct size oral or nasal airway and select the appropriate size adult mask.
 2. Position thumbs over top half of mask, index and middle fingers over bottom half.
 3. Place apex of mask over bridge of nose, then lower mask over mouth and upper chin.
 4. Use ring and little fingers to bring jaw up to mask.
 5. Connect flow restricted, oxygen-powered ventilation device to mask if not already done.
 6. Trigger the flow restricted, oxygen powered ventilation device until chest rises.
 7. Repeat every 5 seconds.
 8. If necessary, consider use of adjuncts.
 9. If chest does not rise, re-evaluate
 - (1) If abdomen rises, reposition head.
 - (2) If air is escaping from under the mask, reposition fingers and mask.
 - (3) Check for obstruction.
 - (4) If chest still does not rise, use alternative method of artificial ventilation, e.g., pocket mask.
 3. Use when there is suspected neck injury.
 1. After opening airway, *select the appropriate size adult mask.*
 2. Immobilize head and neck; e.g., have an assistant hold head manually or use your knees to prevent movement.
 3. Position thumbs over top half of mask, index and middle fingers over bottom half.
 4. Place apex of mask over bridge of nose, then lower mask over mouth and upper chin.
 5. Use ring and little fingers to bring jaw up to mask without tilting head or neck.
 6. Connect flow restricted, oxygen-powered ventilation device to mask, if not already done.

7. Trigger the flow restricted, oxygen-powered ventilation device until chest rises.
8. Repeat every 5 seconds.
9. If necessary, consider use of adjuncts.
10. If chest does not rise and fall, re-evaluate
 - (1) If chest does not rise and fall, reposition jaw.
 - (2) If air is escaping from under the mask, reposition fingers and mask.
 - (3) Check for obstruction.
 - (4) If chest still does not rise, use alternative method of artificial ventilation, e.g., pocket mask.

5. Airway Adjuncts

1. Oropharyngeal (oral) airways

1. 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.
2. Select the proper size: measure from the corner of the patient's lips to the bottom of the earlobe or angle of jaw.
3. Open the patient's mouth.
4. In adults, to avoid obstructing the airway with the tongue, insert the airway upside down, with the tip facing toward the roof of the patient's mouth.
5. Advance the airway gently until resistance is encountered. Turn the airway 180 degrees so that it comes to rest with the flange on the patient's teeth.
6. Another method of inserting an oral airway is to insert it right side up, using a tongue depressor to press the tongue down and forward to avoid obstructing the airway. This is the preferred method for airway insertion in an infant or child.

2. Nasopharyngeal (nasal) airways

1. Nasopharyngeal airways are less likely to stimulate vomiting and may be used on patients who are responsive but need assistance maintaining an airway. Even though the tube is lubricated, this is a painful stimulus.
2. Select the proper size: measure from the tip of the nose to the tip of the patient's ear. Also consider diameter of airway in nare.
3. Lubricate the airway with a water soluble lubricant.
4. Insert it posteriorly. Bevel should be toward the base of the nare or toward the septum.
5. If the airway cannot be inserted into one nostril, try the other nostril.

6. Oxygen

1. Equipment for oxygen delivery

1. Non-rebreather

1. Preferred method of giving oxygen to prehospital patients.

2. Up to 90% oxygen can be delivered.
 3. Non-rebreather bag must be full before mask is placed on patient.
 4. Flow rate should be adjusted so that when patient inhales, bag does not collapse (15 lpm).
 5. Patients who are cyanotic, cool, clammy or short of breath need oxygen. Concerns about the dangers of giving too much oxygen to patients with history of chronic obstructive pulmonary disease and infants and children have not been shown to be valid in the prehospital setting. Patients with chronic obstructive pulmonary disease and infants and children who require oxygen should receive high concentration oxygen.
 6. Masks come in different sizes for adult, children and infants. Be sure to select the correct size mask.
2. Nasal cannula - rarely the best method of delivering adequate oxygen to the prehospital patient. Should be used only when patients will not tolerate a non-rebreather mask, despite coaching from the EMT-Basic.

SUGGESTED APPLICATION

Procedural (How)

1. Demonstrate the steps in performing the skill of artificially ventilating a patient with a bag-valve-mask for one and two rescuers.
2. Demonstrate how to insert an oropharyngeal and nasopharyngeal airway.
3. Demonstrate the use of a non-rebreather face mask and a nasal cannula.
4. Demonstrate artificial ventilation of a patient with a flow restricted, oxygen powered ventilation device.
5. Demonstrate the techniques of suctioning.

Contextual (When, Where, Why)

Every patient must have a patent airway to survive. When the airway is obstructed, the EMT-Basic must clear it as soon as possible using the methods described in this lesson. The only exceptions to this would be situations where it is unsafe or the airway problem is such that it cannot be treated in the field and the patient must be transported immediately to a hospital.

Once the airway has been opened, the EMT-Basic must determine if breathing is adequate. Patients with inadequate breathing must be artificially ventilated using mouth-to-mouth, mouth-to-mask, bag-valve-mask or flow restricted, oxygen-powered ventilation device. If the patient has adequate breathing, the EMT-Basic must decide if supplemental oxygen is indicated. If oxygen is necessary, the EMT-Basic must select the appropriate device and follow the procedure for delivery.

STUDENT ACTIVITIES

Auditory (Hear)

Students should hear a bag-valve-mask device and a flow restricted, oxygen powered ventilation device used on a patient.

Students should hear a suction unit being operated.

Students should hear an oxygen tank and flowmeter in operation.

Visual (See)

Students should see different devices for ventilating a patient such as pocket masks, bag-valve masks and flow restricted, oxygen powered ventilation devices.

Students should see non-rebreather masks and nasal cannulas.

Kinesthetic (Do)

Students should practice opening a patient's airway using a head-tilt chin lift and a jaw thrust maneuver.

Students should practice using a bag-valve-mask device and a flow restricted, oxygen powered ventilation device.

Students should practice using a non-rebreather mask and a nasal cannula

Students should practice correct operation of oxygen tanks, regulators and flow meters.

Students should practice suctioning.

Instructor Activities

Supervise student practice.

Reinforce student progress in cognitive, affective, and psychomotor domains.

Redirect students having difficulty in content.

EVALUATION

Written: Develop evaluation instruments, e.g., quizzes, verbal reviews, and handouts, to determine if the students have met the cognitive and affective objectives of this lesson.

Practical: Evaluate the actions of the EMT-Basic students during role play, practice or other skill stations to determine their compliance with the cognitive and affective objectives and their mastery of the psychomotor objectives of this lesson.

REMEDICATION

Identify students or groups of students who are having difficulty with this subject content.

SUGGESTED ENRICHMENT

What is unique in the local area concerning this topic?