CHAPTER 6

Resuscitation Adjuncts
Successfully managing respiratory and cardiac emergencies requires quick thinking, sound skills, and familiarity with how your equipment operates. When correctly used, suction units help clear the airway, airway devices help maintain an open airway, ventilation devices provide effective barriers against disease transmission, and defibrillators enhance the chance of survival for cardiac arrest patients.

**Suction Devices**

Patients who have vomited, inhaled fluid or debris, or who are bleeding from the nose or mouth are in danger of an airway obstruction. You cannot maintain an open airway or begin rescue breathing until the airway is clear, so that air exchange can occur. Suction devices can help you remove airway obstructions. There are two primary types of suction devices: manual devices and mechanical devices.

**Manual Suction Devices**

Manual suction devices that do not require batteries or an electrical source are among the most convenient to operate. These devices are always ready to work and require minimal servicing. Suction is applied by inserting the tip of the device into the patient's mouth and squeezing its handle to create a vacuum that withdraws debris (Figure 6.1). Manual and mechanical suction devices are used in the same way, described in detail in the following section; the only difference is the power source.

**Mechanical Suction Devices**

Mechanical suction units are powered by rechargeable batteries, pressurized oxygen, or pneumatic (vacuum) devices. These units require familiarity with the mechanisms for their use, as well as regular maintenance and service checks (Figure 6.2). Like manual suction devices, these mechanical devices also create a vacuum that draws obstructing materials from the patient's airway. To use these devices effectively, you must learn how they operate and how to control the force of the suction.

All mechanical suction devices consist of a power unit, disposable suction catheters of various sizes and shapes, an unbreakable collection bottle, suction tubing, and a supply of water for flushing out the tubing and suction catheters. Two types of suction tips are commonly used with mechanical suction devices: the rigid-tip catheter (Figure 6.3) and the flexible whistle-tip catheter (Figure 6.4).

Follow these steps when suctioning:

1. Turn the patient's head to the side. If you suspect a spinal injury, roll the patient onto his or her side and keep the neck and body from twisting.

2. Open the patient's mouth and wipe away any large debris with your gloved fingers.
3. Measure the suction catheter from the corner of the patient's mouth to the earlobe. This gives you the proper depth to insert the end of the suction tip. Inserting the catheter too deeply and attempting to suction is likely to stimulate the patient's vomiting (gag) reflex.

4. Turn on the suction device, insert the suction tip, and suction for no longer than 15 seconds. Suction as you slowly withdraw the catheter from the mouth.

Airways

Once a patient's airway is clear, maintaining the open airway is extremely important. Because the tongue is the most common cause of airway obstruction in an unconscious patient, artificial airways can be used to prevent the tongue from blocking the airway. There are two types of airways: oral and nasal.

Oral Airways

The most commonly used airway is the oral (oropharyngeal) airway (Figure 6.5). It is inserted along the roof of the mouth and rotated into position in the back of the throat. The flange end rests on the lips. This position ensures a clear airway and keeps the tongue from obstructing the airway. Improper placement could force the tongue farther into the pharynx. Because the oral airway may stimulate the oropharynx and cause gagging, it should only be used with unconscious patients who do not have a gag reflex.

There are various sizes of oral airways for infants, children, and adults. Selecting the right size is important. If the oral airway is too large, it can trigger the gag reflex, and vomit could possibly enter the trachea and lungs (aspiration).

Follow these steps when inserting an oral airway:

1. Choose the right size. Measure the device from the corner of the patient's mouth to the earlobe (Figure 6.6).

2. Open the patient's airway by using the head tilt–chin lift or jaw-thrust maneuver.

3. Insert the device along the roof of the patient's mouth, with the curved tip toward the patient's head (Figure 6.7). As the tip approaches the back of the throat, rotate the airway so that the tip points down toward the chest (Figure 6.8). It should slip easily into the throat, with the flange resting against the patient's lips (Figure 6.9).

If the patient is breathing and does not have a spinal injury, roll the patient onto his or her side to avoid aspiration if vomiting occurs. Remove the airway if the patient regains consciousness, swallows, or begins to gag.

Nasal Airways

A conscious patient who has a gag reflex can tolerate a nasal (nasopharyngeal) airway better than an oral airway. Unlike an oral airway, the nasal airway does not cause the patient to gag. It can be used on either responsive or unresponsive patients, but should not
be used on a patient with a suspected skull fracture.

Nasal airways are made of a soft rubber or latex, are inserted through one of the nostrils (Figure 6.10), and follow the nasal passage. Bleeding is a complication that can occur when a nasal airway is inserted. As with an oral airway, choosing the right size nasal airway is very important. If it is too large, it will not fit into the nostril. If it is too small, it will not keep the airway open or allow adequate air exchange.

Follow these steps when inserting a nasal airway:

1. Choose the right size device. It must fit in the patient’s nostril. Measure the tube against the side of the patient’s face, from the tip of the nose to the earlobe (Figure 6.11).

2. Open the airway using either the head tilt–chin lift or the jaw-thrust maneuver.

3. Lubricate the airway with a sterile, water-based lubricant or with water or saline solution if no lubricant is available.

4. Insert the tube through the nostril, following the nasal passage straight back, not upward (Figure 6.12–6.14). Do not force the tube if you meet resistance. Instead, remove the tube and try inserting the airway into the other nostril.

5. Listen and feel for airflow through the tube.

Ventilation Devices

Ventilation Masks

Mouth-to-mask ventilation can deliver an adequate volume of air to a patient if a rescuer ensures a tight mask seal on the face. Ventilation masks, in general, offer some protection from infection. Certain types of masks have an inlet which allows oxygen tubing to be attached to the mask. No matter which mask you choose to use, you must consider a number of issues. The mask must fit well, have a one-way valve, be made of a transparent material, have an oxygen port, and be available in infant, pediatric, and adult sizes (Figure 6.15–6.17).

Masks vary in size and complexity from the simple face shield to the bag-valve-mask device (BVM). Each type of mask has distinct advantages and disadvantages. Because you probably will not have the option of choosing the mask you prefer in an emergency, you should learn how to use all types correctly.
Follow these steps when performing mouth-to-mask rescue breathing:

1. Position yourself at the patient’s head.
2. Open the patient’s airway using either the head tilt–chin lift or the jaw-thrust maneuver (Figure 6.18).
3. Place the mask over the patient’s mouth and nose.
4. Using both hands, grasp the mask and the patient’s jaw. Press down on the mask with your thumbs, as you lift up on the jaw with your fingers. This will create a good seal on the mask and face (Figure 6.19).
5. Place your mouth over the mouthpiece and perform rescue breathing as described in Chapter 4 (Figure 6.20).

**Multi-Lumen Airways**

Multi-lumen airways are devices which are inserted into the mouth without direct visualization of the vocal cords. They have been designed to maintain an airway and provide for proper lung ventilation when inserted in either the trachea or the esophagus. Commonly used multi-lumen airways are the Esophageal Tracheal Combitube (ETC)™, the Pharyngeotracheal Lumen Airway (PtL)™, and the Laryngeal Mask Airway (LMA).

The benefits associated with these devices include:

- Ease of placement (blind insertion)
- No mask seal needed
- Protects the airway from obstructions

The complications associated with these devices include:

- Ineffective if the cuff malfunctions
- Requires proper assessment of lung sounds
- Cannot be used on patients smaller than 5 feet

The ETC airway consists of a double lumen tube and two balloon cuffs (Figure 6.21, page 52). The blue lumen is the primary ventilation tube, used if the tube is inserted into the esophagus (Figure 6.22 A, page 52). The clear lumen is the secondary ventilation tube, used if the tube is inserted into the trachea (Figure 6.22 B, page 52). The clear cuff at the lower end of the tube seals off the trachea or the esophagus when it is inflated following tube insertion. The flesh-colored cuff near the middle of the tube seals off the oropharynx and nasopharynx. Two pilot balloons correspond to the two cuffs. When syringes are attached to the pilot balloons, they inflate the two cuffs.

The PtL airway consists of two primary tubes (green and clear), two balloon cuffs, a stylet, bite block, and neck strap (Figure 6.23, page 52). A third, clear tube passes through the larger diameter green tube. It contains the stylet and a cuff near the tip. The stylet is left in as a plug if the tube is placed in the esophagus, but removed if it is placed in the trachea (Figure 6.24 A, B, page 52).
Figure 6.21 The Esophageal Tracheal Combitube (ETC). The ETC consists of a double lumen tube and two balloon cuffs. The blue lumen is the primary ventilation port, and the clear lumen is the ventilation port if the tube is placed in the trachea.

Figure 6.22 A. If the ETC is inserted into the trachea, it functions as an ETT with ventilations provided directly into the trachea. B. If the ETC is inserted into the esophagus, ventilations can still be provided to the patient.

Figure 6.23 The Pharyngeotracheal Lumen Airway (PtL).

Figure 6.24 The PtL is inserted blindly into the oropharynx. A. If the PtL is inserted into the trachea, it functions as an ETT with ventilations provided directly into the trachea. B. If the PtL is inserted into the esophagus, ventilations can still be provided to the patient.

The LMA consists of a tube and a mask-like cuff at the end, that when in place blocks the larynx allowing air to enter the trachea only (Figure 6.25). The LMA is inserted in the mouth and slid down the back of the throat until resistance is met. The cuff is inflated to seal the larynx, allowing air to go into the trachea.

Bag-Valve-Mask Devices

The bag-valve-mask device (BVM) is a hand-held device with three main components: a bag, a valve, and a mask. The bag is self-inflating. When you squeeze it, it automatically reinflates. The valve is a one-way device that prevents the patient's exhaled air from entering the bag. The mask is similar to that used in mouth-to-mask rescue breathing. The BVM device is used with an oral or nasal airway. The BVM device delivers a higher concentration of oxygen than a ventilation mask alone, approximately 90% to 100% oxygen when attached to an oxygen source. Even without supplemental oxygen, the BVM device provides approximately 21% oxygen, which is also greater than the 16% oxygen provided by mouth-to-mouth or mouth-to-mask rescue breathing.
To use the BVM device effectively, you must practice regularly. The best results are achieved when two rescuers use the device. One rescuer maintains an open airway and mask seal, while the second rescuer squeezes the bag (Figure 6.26). The bag should be squeezed smoothly, not forcefully. Forceful compression of the bag, like forceful rescue breathing, will result in air entering the patient’s stomach instead of the lungs.

**Oxygen-Powered Ventilators**

Oxygen-powered ventilators are similar to BVM devices, but instead of squeezing a bag to force air into the patient’s lungs, you press a button or trigger. These devices attach to an oxygen cylinder (Figure 6.27). Like BVM devices, oxygen-powered ventilators can deliver between 90% and 100% oxygen. The advantages of oxygen-powered ventilators include delivery of a high oxygen concentration, protection from disease, and easy use. The major disadvantage is the need for an oxygen source to power the device. Once the oxygen is depleted, the device can no longer be used. Because the oxygen is delivered under a higher pressure, you must be careful not to overinflate the patient’s lungs or cause gastric distention. These devices also cost more than the other ventilation devices discussed. Consult your local protocols regarding the use of oxygen-powered ventilators in your area.

**Automated External Defibrillation**

More than half of the deaths from sudden cardiac arrest each year result from an abnormal heart rhythm known as ventricular fibrillation. The most important factor for surviving a cardiac arrest is early defibrillation. By applying defibrillator pads to the chest and administering a shock, you may be able to reestablish a normal cardiac rhythm. In the defibrillation process, a direct electrical current (DC) is passed through the heart to momentarily stop all electrical activity. After this occurs, the heart’s normal pacemaker cells will take command of the heart’s electrical activity and produce a coordinated, regular heartbeat.

The time from cardiac arrest to defibrillation is a crucial factor in determining survival. The earlier defibrillation can be performed, the greater a patient’s chances of survival. After 8 to 10 minutes of cardiac arrest, damage to the heart may be so extensive that the individual can no longer survive (Figure 6.28).

Although not all cardiac arrest patients will need defibrillation, most adults in cardiac arrest will be in ventricular fibrillation, a condition that can be corrected by defibrillation. For this reason, national efforts have been made to advocate placing low-cost, easy-to-use automated defibrillators where they will be most useful. These defibrillators, known as automated external defibrillators (AEDs), are now being placed in stadiums, shopping malls, factories, schools, aircraft, and police and fire vehicles, so that they can be used quickly when the need arises.
The Heart's Electrical System

The normal pacemaker in the heart is the sinoatrial node (SA node). Approximately every second it emits an electrical impulse that travels along pathways through the atria, causing them to contract. This signal is received at the atrioventricular node (AV node), between the atria and the ventricles. The AV node acts as a relay station. Below it, the electrical pathway divides into two main branches, serving the two ventricles. When the electrical impulse reaches the Purkinje fibers in the ventricles, it causes the muscular walls of the ventricles to contract. This ventricular contraction forces blood to surge from the heart throughout the body, resulting in a characteristic pulse (Figure 6.29).

Abnormal Electrical Activity

Ventricular fibrillation (V-fib) occurs when irregular electrical impulses originate from multiple sites in the ventricles. The heart muscle reacts erratically, trying to respond to too many signals. A chaotic ventricular rhythm results in the fibrillation, or quivering, of the ventricles, instead of a strong contraction. Fibrillation does not produce blood flow from the heart.

Another abnormal electrical rhythm is ventricular tachycardia (V-tach). In V-tach, the heart beats at a rapid rate of between 150 and 200 beats per minute. At this rate, contractions become ineffective and the heart is unable to pump enough blood out (Figure 6.30–6.32).

Automated External Defibrillation

There are many different models of automatic external defibrillators (AEDs). The principles are the same for each, but displays, controls, and options vary. Some models have screens that display the rhythm and provide both visual and verbal prompts. Others have only a visual prompt screen. Some have no screens at all. There are also different combinations of recording devices for documenting and transferring patient information. Some devices automatically analyze the rhythm,
whereas others require the operator to press a button to begin analysis. Consult the manufacturer’s recommendations for your specific model before using it (Figure 6.33).

To use an AED, you must have a patient who is unresponsive, not breathing, and has no signs of circulation (e.g., no pulse). Determine unresponsiveness, check for breathing, provide two initial ventilations if the patient is not breathing, and check circulation. If the pulse is absent, begin CPR until the AED is ready. When two rescuers are at the scene, one should set up the AED while the other performs CPR. If you are alone and have an AED, you should apply the AED before starting CPR.

Follow these steps when using an AED:

1. Place the AED near the patient’s head and turn it on.
2. Expose the patient’s chest and make certain the skin is clean and dry. If necessary, dry the skin with a towel.
3. Attach the AED cables to the pads.
4. Remove the adhesive backing from the two AED pads and apply them to the chest. Place the sternum pad on the upper right border of the sternum, so that the top edge of the pad is just below the collar bone (clavicle). Place the apex pad on the left lower ribs, below and to the left of the nipple.
5. Stop CPR (if in progress), do not touch the patient, and “analyze” the heart rhythm. Some devices require you to press the analyze button, while others do this automatically once the pads are in place. The AED will now analyze the patient’s heart rhythm. If the patient is in ventricular fibrillation or ventricular tachycardia (over 180 beats/min), the AED will recommend defibrillation.
6. If defibrillation is recommended, stand back from the patient and make sure no one is in contact with the patient (Figure 6.34).
7. Press the button marked “shock.” The AED will re-analyze the heart rhythm. If the first shock does not correct the abnormal electrical rhythm, the AED will advise you to shock again. Repeat this process for up to three initial shocks. After the third shock, check for a pulse.
8. If the pulse is still absent, perform CPR for one minute. Recheck for a pulse and, if it is still absent, analyze the rhythm again and repeat up to three more shocks. Three sets of three shocks, with CPR between each set, are the maximum recommended number.

If the cables or pads are not secure, the AED will give you an error warning. Likewise, movement of the patient or the machine can interfere with analysis, which is why you should not use an AED in a moving vehicle, such as an ambulance.

If the patient’s rhythm converts, but he or she still does not have a pulse, you should transport the patient while performing CPR. This patient, as well as one who does not respond to defibrillation, needs additional advanced measures or has suffered too great an injury to survive.
AED Precautions

When using an AED:

- Do not use alcohol to wipe the patient’s chest before placing the pads.
- Do not apply the pads over any medication patches, such as nitroglycerin (Figure 6.35).
- Do not apply the pads over any implanted pacemaker or defibrillator.
- Do not attach the pads to any patient unless he or she is unresponsive, not breathing, and pulseless.
- Do not defibrillate a patient who is lying on a surface likely to conduct electricity.
- Do not depress the shock button or analyze the rhythm until everyone is clear of the patient.
- For children ages 1-8, use an AED that has shown to be accurate for this age group. Use pediatric electrode pads if available with the device (Figure 6.36).

Maintenance

AEDs can greatly improve the chance of survival for a victim of cardiac arrest if applied quickly and properly. But the device must also function properly when it is applied. To be certain that your AED will function properly when needed, you must inspect it regularly as part of preventive maintenance. Daily inspections should include checks to ensure all the supplies are on hand, the unit is operational, the batteries charged, and there is no damage to the unit. When an AED is turned on, it will perform a series of self-diagnostic tests to ensure proper operation. Additionally, expiration dates should be checked on pads and batteries. The check point on the facing page can be used as a guide during your checks. Proper documentation should be kept of these inspections. If the unit should fail to function during an actual emergency, your documentation will be very important as the incident is reviewed.
### Checkpoint

**Automated External Defibrillator**

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<tr>
<th>Skill</th>
<th>Satisfactory</th>
<th>Unsatisfactory</th>
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<tr>
<td>Check for scene safety</td>
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<td>Check patient</td>
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<tr>
<td>Check responsiveness</td>
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<tr>
<td>If unresponsive, open the airway</td>
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<td>Check for breathing</td>
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<tr>
<td>If not breathing, deliver two slow breaths</td>
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<td>Check for carotid pulse</td>
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<tr>
<td>If pulse is absent begin CPR until an AED is available (and call 9-1-1 if not already done)</td>
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**Defibrillation:**

- Power is turned on
- Electrodes attached to cables
- Ensure clean/dry skin surface
- Electrodes correctly applied
- Clear patient
- Initiate analyze mode
- If shock is indicated:
  - a. Clear victim
  - b. Deliver shock
  - c. Initiate analyze mode
  - d. Deliver up to 3 shocks as indicated
  - e. Check circulation (pulse)
  - f. If no pulse, perform one minute of CPR
  - g. Initiate analyze mode
- If shock is indicated, repeat steps a–g
- If no shock is indicated:
  - Check circulation
  - Perform one minute of CPR if needed
  - Initiate analyze mode

**Evaluator:** ________________________________

**Student’s Name ________________________________ Date _____________________________

**Evaluator: ________________________________**
A clear airway is needed before you can maintain an open airway or begin rescue breathing. Airway obstructions may be caused by anatomical conditions, such as the tongue blocking the airway, which require minimal efforts to correct. Other times, the airway may be obstructed by foreign material such as food, fluid, or vomitus. Manual and mechanical suction units are available to help remove this debris. Mechanical suction devices are powered by batteries or pressurized oxygen, or are pneumatic (vacuum) devices. Whichever type of suction device you use, it is important to understand the machinery and not to suction too deeply.

Patients can benefit from devices that help you maintain an open airway. If the patient is unconscious and has no gag reflex, you can use an oral or nasal airway device. Select the correct size device to avoid triggering a gag reflex or blocking the airway. You can also use a nasal airway device on a conscious patient but not on a patient with a suspected skull fracture.

Ventilation devices are available to support ventilation efforts and reduce the risk of disease transmission. These devices can be simple ventilation masks, bag-valve-mask (BVM) devices, or oxygen-powered ventilators. The latter two devices can provide oxygen concentrations between 90% and 100% to the patient. Other devices designed to aid airway and ventilation are multi-lumen airways, such as the ETC or PtL.

The single most important cardiac arrest survival factor is early defibrillation. The indications for using an automated external defibrillator (AED) are that the patient is unresponsive, not breathing, and pulseless. Once turned on and attached to the patient’s bare chest, the AED will analyze the heart rhythm and advise whether it is necessary to deliver a shock. If no shock is advised, but the patient still does not have a pulse, CPR must be performed until advanced cardiac care personnel arrive.

Checking Your Progress

1. To remove large debris or pieces of food from the mouth of an unresponsive patient, you should use
   - A. A bulb syringe device
   - B. Your gloved fingers
   - C. An oral airway
   - D. A nasal airway

2. Which of the following should be done when suctioning a patient’s airway?
   - A. Turn the head of a patient with a suspected spinal injury to the side
   - B. Suction for 20 to 30 seconds
   - C. Suction as you withdraw the catheter tip from the patient’s mouth
   - D. Measure the tube from the patient’s forehead to the chin

3. You can use an oral airway device only on a patient who
   - A. Has a pulse
   - B. Is responsive and has a gag reflex
   - C. Is unresponsive and has no gag reflex
   - D. Is over 12 years old and weighs more than 90 pounds
4. Use a nasal airway device on a patient who
   A. Has a possible skull fracture
   B. Is responsive or unresponsive
   C. Is over 12 years old and weighs more than 90 pounds
   D. All of the above

5. Although mouth-to-mouth is an effective method of rescue breathing, it may result in disease transmission. A safer and equally effective method of performing rescue breathing is to use
   A. An oral airway
   B. A ventilation mask
   C. A two-person bag-valve-mask device
   D. B or C

6. To deliver 90% to 100% oxygen to the patient, you would have to use
   A. An oxygen-powered ventilator
   B. A ventilation mask
   C. Mouth-to-mouth rescue breathing
   D. A or B

7. To be most effective, a bag-valve-mask device should be used with
   A. Two rescuers
   B. A reservoir
   C. Supplemental oxygen
   D. All of the above

8. In order for mouth-to-mask rescue breathing to be effective, you must
   A. Maintain a loose seal to allow air to flow evenly
   B. Maintain an open airway
   C. Cover the mouth, but leave the nose uncovered to allow for exhalation
   D. All of the above

9. The most important factor for survival in sudden cardiac arrest is
   A. Alerting EMS within 10 minutes
   B. Early defibrillation
   C. Rescue breathing with a ventilation device
   D. Clearing the airway

10. After three unsuccessful shocks, you should check circulation. If there are no signs of circulation (e.g., no pulse) you should
    A. Perform one minute of CPR, then analyze the rhythm again
    B. Defibrillate once more
    C. Transport
    D. Remove the AED because it is not working