CHAPTER

11

# BLS Resuscitation

## National EMS Education Standard Competencies

### Shock and Resuscitation

Applies a fundamental knowledge of the causes, pathophysiology, and management of shock, respiratory failure or arrest, cardiac failure or arrest, and post resuscitation management.

### Knowledge Objectives

1. Explain the elements of basic life support (BLS), how it differs from advanced life support (ALS), and the urgency surrounding its rapid application. (pp 413–414, 416–417)
2. Explain the goals of cardiopulmonary resuscitation (CPR) and when it should be performed on a patient. (p 414)
3. Explain the system components of CPR, the four links in the American Heart Association chain of survival, and how each one relates to maximizing the survival of a patient. (pp 414–415)
4. Discuss guidelines for circumstances that require the use of and automated external defibrillator (AED) on both adult and pediatric patients experiencing cardiac arrest. (p 415)
5. Explain three special situations related to the use of automated external defibrillation. (p 416)
6. Describe the proper way to position an adult patient to receive basic life support. (pp 417–418)
7. Describe the two techniques an EMT may use to open an adult patient's airway and the circumstances that would determine when each technique would be used. (pp 419–421)
8. Describe the purpose of external chest compressions. (pp 418–419)
9. Describe the recovery position and circumstances that would warrant its use as well as situations in which it would be contraindicated. (p 421–422)
10. Describe the process of providing artificial ventilations to an adult patient using a barrier device, ways to avoid gastric distention, and modifications required for a patient with a stoma. (pp 422–424)
11. Explain the steps in providing one-rescuer adult CPR. (pp 424–426)
12. Explain the steps in providing two-rescuer adult CPR, including the method for switching positions during the process. (pp 424–428)
13. Describe the different mechanical devices that are available to assist emergency responders in delivering improved circulatory efforts during CPR. (pp 428–429)
14. Describe the different possible causes of cardiopulmonary arrest in children. (pp 429–430)
15. Explain the four steps of pediatric basic life support (BLS) procedures and how they differ from procedures used in an adult patient. (pp 429–435)
16. Describe the ethical issues related to patient resuscitation, providing examples of when not to start CPR on a patient. (pp 436–437)
17. Explain the various factors involved in the decision to stop CPR once it has been started on a patient. (p 436–437)
18. Explain common causes of foreign body airway obstruction in both children and adults and how to distinguish mild or partial airway obstruction from complete airway obstruction. (pp 437–441)
19. Describe the different methods for removing a foreign body airway obstruction in an infant, child, and adult, including the procedure for a patient with an obstruction who becomes unconscious. (pp 438–443)

### Skills Objectives

1. Demonstrate how to reposition an unconscious adult for airway management. (pp 417–418, Skill Drill 11-1)
2. Demonstrate how to check for a pulse at the carotid artery in an unresponsive patient. (p 417)
3. Demonstrate how to perform external chest compressions in an adult. (pp 419–420, Skill Drill 11-2)
4. Demonstrate how to perform a head tilt–chin lift maneuver on an adult patient. (pp 419–421)
5. Demonstrate how to perform a jaw-thrust maneuver on an adult patient. (p 420–421)
6. Demonstrate how to place a patient in the recovery position. (pp 421–422)
7. Demonstrate how to perform rescue breathing in an adult with a simple barrier device. (pp 422–423)
8. Demonstrate how to perform one-rescuer adult CPR. (pp 424–426, Skill Drill 11-3)
9. Demonstrate how to perform two-rescuer adult CPR. (pp 424–428, Skill Drill 11-4)
10. Demonstrate how to perform a head tilt–chin lift maneuver on a pediatric patient. (p 434)
11. Demonstrate how to perform a jaw-thrust maneuver on a pediatric patient. (p 434)
12. Demonstrate the use of mechanical devices that assist emergency responders in delivering improved circulatory efforts during CPR. (pp 428–429)
13. Demonstrate how to perform rescue breathing on a child. (pp 434–435)
14. Demonstrate how to perform rescue breathing on an infant. (pp 432–433)
15. Demonstrate how to perform external chest compressions on an infant. (pp 431–433, Skill Drill 11-5)
16. Demonstrate how to perform CPR in a child who is between 1 year of age and the onset of puberty. (pp 432–433, Skill Drill 11-6)
17. Demonstrate how to remove a foreign body airway obstruction in a conscious adult patient using abdominal thrusts (Heimlich maneuver). (p 439)
18. Demonstrate how to remove a foreign body airway obstruction in a conscious pregnant or obese patient using chest thrusts. (pp 439–440)
19. Demonstrate how to remove a foreign body airway obstruction in a conscious child older than 1 year using abdominal thrusts (Heimlich maneuver). (pp 440–441)
20. Demonstrate how to remove a foreign body airway obstruction in an unconscious child. (pp 441–443, Skill Drill 11-7)
21. Demonstrate how to remove a foreign body airway obstruction in an infant. (pp 441–442)

## Introduction

The principles of basic life support (BLS) were introduced in 1960. Since then, the specific techniques have been reviewed and revised every 5 to 6 years. The updated guidelines are published in peer-reviewed journals: *Circulation* in the United States and *Resuscitation* in Europe. The most recent revision occurred as a result of the 2010 Conference on Cardiopulmonary Resuscitation and Emergency Cardiac Care. The information in this chapter follows the 2010 guidelines and presents a review of BLS.

This chapter begins with a definition and general discussion of BLS. The chapter then discusses methods for opening and maintaining an airway, providing artificial ventilation to a person who is not breathing, providing artificial circulation to a person with no pulse, and removing a foreign body airway obstruction. Each of these topics is followed by a review of the changes in technique that are necessary to treat infants and children. A discussion of the methods of preventing the transmission of infectious diseases during cardiopulmonary resuscitation (CPR) is provided in Chapter 2, *Workforce Safety and Wellness*. A discussion of the anatomy and physiology of the respiratory and cardiovascular systems can be found in Chapter 5, *The Human Body*.

### Words of Wisdom

Although your chances of contracting a disease during CPR training or actual CPR on a patient are very low, common sense and Occupational Safety and Health Administration (OSHA) guidelines both demand that you take reasonable precautions to prevent unnecessary exposure to infectious disease. Using standard precautions makes the risk of contracting disease from CPR extremely low.

## Elements of BLS

**Basic life support (BLS)** is noninvasive emergency lifesaving care that is used to treat medical conditions, including airway obstruction, respiratory arrest, and cardiac arrest. This care focuses on what is often termed the ABCs: airway (obstruction), breathing (respiratory arrest), and circulation (cardiac arrest or severe bleeding). If cardiac arrest is suspected, the order becomes CAB because chest compressions are essential and must be started as quickly as possible Figure 11-1. BLS follows a specific sequence for adults and for infants and children. Ideally, only

Figure 11-1 CAB: Chest compressions, airway, and breathing.

## You are the Provider: PART 1

At 2:45 PM, you and your partner respond to a local supermarket where a middle-aged man reportedly collapsed in the parking lot. While you are en route to the scene, dispatch advises you that bystander CPR is in progress. Your response time is less than 5 minutes.

1. What should you immediately do on receiving this update from dispatch?
2. What should be your initial actions on arriving at this scene?

seconds should pass between the time you recognize that a patient needs BLS and the start of treatment. Remember, brain cells die every second that they are deprived of oxygen. Permanent brain damage is possible if the brain is without oxygen for 4 to 6 minutes. After 6 minutes without oxygen, brain damage is likely Figure 11-2.

If a patient is not breathing well or at all, you may simply need to open the airway. Very often, this helps the patient to breathe normally again. However, if the patient has no pulse, you must combine artificial ventilation with artificial circulation beginning with compressions. If breathing stops before the heart stops, the patient will have enough oxygen in the lungs to stay alive for several minutes. But when cardiac arrest occurs first, the heart and brain stop receiving oxygen immediately.

Cardiopulmonary resuscitation (CPR) is used to establish artificial ventilation and circulation in a patient who is not breathing and has no pulse. The steps for CPR include the following:

1. First, restore circulation by means of chest compressions to circulate blood through the body.
2. After performing 30 high-quality compressions at least 2″ deep in an adult and at the rate of at least 100 per minute, open the airway with the jaw-thrust or head tilt–chin lift maneuver.
3. Last, restore breathing by means of rescue breathing (mouth-to-mouth ventilation, mouth-to-nose ventilation, or the use of mechanical ventilation devices).

The goal of CPR is to restore spontaneous breathing and circulation; however, advanced procedures such as medications and defibrillation are often necessary for this to occur. For CPR to be effective, you must be able to easily identify a patient who is in respiratory and/or cardiac arrest and immediately begin BLS measures Figure 11-3.

BLS differs from advanced life support (ALS), which involves advanced lifesaving procedures, such as cardiac monitoring, administration of intravenous fluids and medications, and use of advanced airway adjuncts. However, when done correctly, BLS can maintain life for a short time until ALS measures can be started. In some cases, such as choking, near drowning, or lightning injuries, early BLS measures may be all that is needed to restore a patient's pulse and breathing. Of course, these patients still require transport to the hospital for evaluation.

The BLS measures are only as effective as the person who is performing them. Whereas your skills may be very good immediately after training, as time goes on, skills will deteriorate unless you practice them regularly.

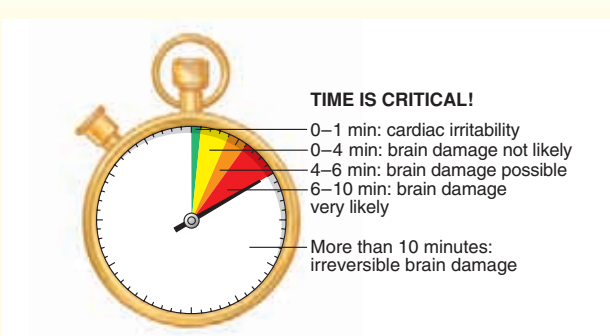



Figure 11-2 Time is critical for patients who are not breathing. If the brain is deprived of oxygen for 4 to 6 minutes, brain damage is possible.

Figure 11-3 You must quickly identify patients in respiratory and/or cardiac arrest so that BLS measures can begin immediately.

## The System Components of CPR

### Chain of Survival

Few people who experience cardiac arrest in the prehospital environment survive unless a rapid sequence of events takes place. The American Heart Association has determined an ideal sequence of events, termed the chain of survival, that if taken can improve the chance of successful resuscitation of a patient who has an occurrence of sudden cardiac arrest Figure 11-4. The five links in the chain of survival are as follows:

- **Early access.** This link requires public education and awareness in the recognition of early warning signs of a cardiac emergency and immediate activation of EMS. "Access EMS by calling 9-1-1" is the first step in the chain so that emergency responders are dispatched to the scene quickly, thus allowing the other links of the chain to occur. In addition, 9-1-1 prearrival instructions can be given on notification and the emergency dispatcher can direct the caller to provide CPR compressions as needed.

- **Early CPR.** Immediate bystander CPR is essential for successful resuscitation of a person in cardiac arrest. CPR will keep blood, and therefore oxygen, flowing to the vital organs to keep them alive until the other components of the chain are available. The more people trained in CPR in the community, the better the chances of CPR being administered quickly to a person in cardiac arrest. Research shows that quick initiation of CPR can double to triple the chances of survival. The lay public as well as emergency responders should all be trained in CPR. In addition, all family members should be trained and ready to provide CPR if the need ever arises because 75% of sudden cardiac arrests occur in the home.
- **Early defibrillation.** Of all the links, early defibrillation offers the best opportunity to achieve a successful patient outcome. Automated external defibrillators (AEDs) have become readily available in many schools, fitness clubs, concert venues, sports arenas, and government buildings.
- **Early advanced care.** Advanced cardiac life support includes advanced airway placement, manual defibrillation, intravenous (IV) or intraosseous (IO) access, and administration of medications, which together increase the chance of a successful resuscitation.
- **Integrated post-arrest care.** The final step in the chain of survival is integrated post-arrest care. This refers to controlling temperature to optimize neurologic recovery in the field and maintaining glucose levels in the patient who is hypoglycemic. It also includes cardiopulmonary and neurologic support at the hospital, therapeutic hypothermia, percutaneous coronary interventions when indicated, and an electroencephalogram to detect seizure activity.

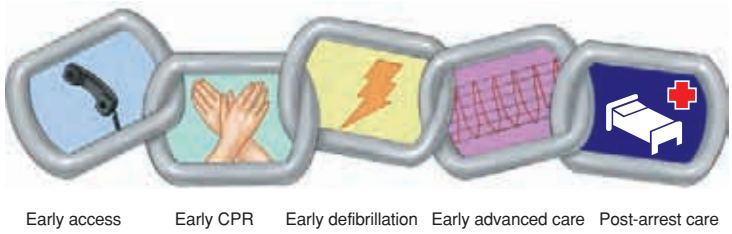



**Figure 11-4** The five links of the chain of survival.
Source: American Heart Association.

If any one of the links in the chain is absent, the patient is more likely to die. For example, few patients survive cardiac arrest if CPR is not administered within the first few minutes of the arrest. Likewise, if the time from cardiac arrest to defibrillation is more than 10 minutes, the chance of survival is minimal. The best chance of survival occurs when all links in the chain are strong.

## Automated External Defibrillation

Most prehospital cardiac arrests occur as the result of a sudden cardiac rhythm disturbance (arrhythmia), such as ventricular fibrillation (V-fib) or pulseless ventricular tachycardia (V-tach). The normal heart rhythm is known as normal sinus rhythm. Ventricular fibrillation is the disorganized twitching of the ventricles, resulting in no blood flow and a state of cardiac arrest. Ventricular tachycardia is a rapid contraction of the ventricles that does not allow for normal filling. As mentioned previously, according to the American Heart Association, early defibrillation is the link in the chain of survival that is most likely to improve survival rates. For each minute the patient remains in V-fib or pulseless V-tach, there is a 7% to 10% less chance of survival.

The automated external defibrillator (AED) should be applied to any cardiac arrest patient as soon as it is available. If indicated, defibrillation should be performed immediately. The simple design of the AED makes it easy for emergency medical responders and lay persons to use with very little training.

When a patient is in cardiac arrest, you should begin CPR starting with chest compressions and apply an AED as soon as it is available. Chapter 14, *Cardiovascular Emergencies*, covers AED use in detail.

### Words of Wisdom

When operating an AED, make sure that no one is injured, including yourself. Be sure no one is touching the patient. Do not defibrillate a patient who is in pooled water. Do not defibrillate someone who is touching metal that others are touching. Finally, carefully remove any medication patches from a patient's chest with your gloved hands, and wipe the area with a dry towel before defibrillation to prevent ignition of the patch.

## AED Usage in Children

AEDs can safely be used in children using the pediatric-sized pads and a dose-attenuating system (energy reducer). However, if these are unavailable, you should use an adult AED. During CPR, the AED should be applied to infants or children after the first five cycles of

CPR have been completed. Cardiac arrest in children is usually the result of respiratory failure; therefore, oxygenation and ventilation are vitally important. After the first five cycles of CPR, the AED should be used to deliver shocks in the same manner as with an adult patient.

If the child is between 1 month and 1 year of age (an infant), a manual defibrillator is preferred to an AED; however, this is a paramedic-level skill. Therefore, call for paramedic backup immediately if you suspect an infant may be in cardiac arrest. If paramedic backup with a manual defibrillator is not available, an AED equipped with a pediatric dose attenuator is preferred. If neither is available, an AED without a pediatric dose attenuator may be used.

### Words of Wisdom

AEDs are becoming more and more accessible in the community. Be familiar with your local protocols on pediatric defibrillation. Your service may use a pediatric AED or an AED with a pediatric adapter.

Remember, if the child is past the onset of puberty (12 to 14 years of age signified by breast development on females and underarm, chest, and facial hair on males), use the adult CPR sequence, including the use of an adult AED.

## Special AED Situations

Safety to you, others at the scene, and the patient should always be a priority. As such, it is important to keep some factors in mind when using an AED unit.

### Pacemaker

You may encounter a patient who has an implanted defibrillator or pacemaker that delivers shocks directly to the heart if necessary. These patients usually have a high risk of sudden cardiac arrest. It is easy to recognize these devices because they create a hard lump beneath the skin in the chest, near the heart. If the electrical pads are placed directly over the device, it may block any shock delivered by the AED unit. Therefore, if you identify an implanted defibrillator or pacemaker, you should place the AED electrodes at least 1″ to the side of the device.

Occasionally, the implanted device will deliver shocks to the patient. If you observe the patient's muscles twitching as if just shocked, wait 30 to 60 seconds before delivering a shock from the AED.

### Wet Patients

Water is a good conductor of electricity. Therefore, the AED unit should not be used in water. If the patient's chest is covered with water, the electrical current may move across the skin rather than between the pads to the patient's heart. If the patient is in water, pull him or her out of the water and quickly dry the skin before attaching the electrodes. If the patient is in a small puddle of water or in the snow, the AED can be used, but the patient's chest should be dry.

### Transdermal Medication Patches

You may encounter a patient who is receiving medication through a transdermal medication patch. The medication is absorbed through the skin. The patch could block the electrical current to the heart and may cause a burn to the skin. To prevent this, remove the patch and wipe the skin to remove the medication residue prior to attaching the AED pads.

## Assessing the Need for BLS

As always, begin by surveying the scene. Is the scene safe? How many patients are there? What is your initial impression of the patients? Are there bystanders who may have additional information? What is the mechanism of injury or nature of illness? Do you suspect trauma? If you were dispatched to the scene, does the dispatch information match what you are seeing?

Because of the urgent need to start CPR in a pulseless, nonbreathing patient, you must complete a primary assessment as soon as possible and begin CPR with chest compressions. The first step is determining unresponsiveness and checking for breathing Figure 11-5. Clearly, a patient who is conscious does not need CPR. A person who is unresponsive may or may not need CPR; to determine unresponsiveness, gently tap the patient on the shoulder and shout "are you okay?" If the patient does not respond to verbal or physical stimulation, he or she is unconscious.

If you suspect the presence of a cervical spine injury, you must take steps to protect the spinal cord from further injury as you perform CPR. If there is even a remote

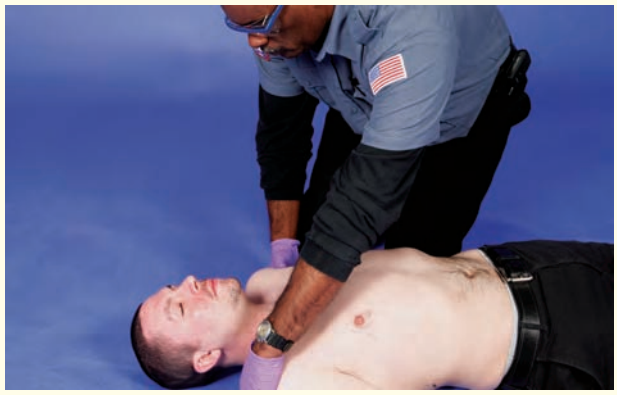


Figure 11-5 Assess an unresponsive patient by first attempting to rouse him or her by tapping on the shoulder.

possibility of this type of injury, you should begin taking appropriate precautions during the primary assessment.

The basic principles of BLS are the same for infants, children, and adults. For the purposes of BLS, anyone younger than 1 year is considered an infant. A child is between 1 year of age and the onset of puberty (12 to 14 years of age). Adulthood is from the onset of puberty and older. Children vary in size. Some small children may best be treated as infants, some larger children as adults. There are two basic differences in providing CPR for infants, children, and adults. The first is that the emergencies in which infants and children require CPR usually have different underlying causes. The second is that there are anatomic differences in adults, children, and infants, such as smaller airways in infants and children than in adults.

Although cardiac arrest in adults usually occurs before respiratory arrest, the reverse is true in infants and children. In most cases, cardiac arrest in children results from respiratory arrest. If untreated, respiratory arrest will quickly lead to cardiac arrest and death. Respiratory arrest in infants and children has a variety of causes, including aspiration of foreign bodies into the airway, such as parts of hot dogs, peanuts, candy, or small toys; airway infections, such as croup and epiglottitis; near-drowning incidents or electrocution; and sudden infant death syndrome (also known as SIDS).

## Positioning the Patient

The next step in providing CPR is to position the patient to ensure that the airway is open. For CPR to be effective, the patient must be lying supine on a firm, flat surface, with enough clear space around the patient for two rescuers to perform CPR. If the patient is crumpled up or lying face down, you will need to reposition him or her. The few seconds that you spend to position the patient properly will greatly improve the delivery and effectiveness of CPR.

Follow the steps in Skill Drill 11-1 to reposition an unconscious adult for airway management:

### Skill Drill 11-1

1. Kneel beside the patient. You and your partner must be far enough away so that the patient, when rolled toward you, does not come to rest in your lap Step 1.
2. Place your hands on either side of the patient's head and neck to protect the cervical spine if you suspect spinal injury. Your partner places his or her hands on the patient's distant shoulder and hip Step 2.
3. Your partner turns the patient toward him or her by pulling on the patient's distant shoulder and hip. Control the head and neck so that they move as a unit with the rest of the torso. This single motion will allow the head, neck, and back to stay in the same vertical plane and will minimize aggravation of any spinal injury Step 3.
4. Place the patient in a supine position, with the legs straight and both arms at the sides Step 4.

If possible, log roll the patient onto a long backboard as you are positioning him or her for CPR. This device will provide support during transport and emergency care. Once the patient is properly positioned, you can easily assess airway, breathing, circulation, and the need for defibrillation and start CPR if necessary.

## Check for a Pulse

Once you have determined that the patient is unresponsive and not breathing or not breathing normally (ie, only gasping), and the patient has been properly positioned for management, you will need to quickly check the patient's pulse and begin chest compressions.

Cardiac arrest is determined by the absence of a palpable pulse at the carotid artery. Feel for the carotid artery by locating the larynx at the front of the neck and then sliding two fingers toward one side (the side closest to you). The pulse is felt in the groove between the larynx and the sternocleidomastoid muscle, with the pads of the index and middle fingers held side by side Figure 11-6. Light pressure is sufficient to palpate the pulse. Check the pulse for at least 5 seconds but no longer than 10 seconds; if a pulse cannot be felt, begin chest compressions.

If the patient has a pulse, but is not breathing, provide rescue breaths (described later in this chapter), at a rate of 10 to 12 breaths/min or one every 5–6 seconds for an adult and one every 3–5 seconds for an infant or child.

Figure 11-6 Feel for the carotid artery by locating the larynx, then slide your index and middle fingers toward one side. You can feel the pulse in the groove between the larynx and sternocleidomastoid muscle.

# Skill Drill 11-1

## Positioning the Patient

**Step 1** Kneel beside the patient, leaving room to roll the patient toward you.

**Step 2** Grasp the patient, stabilizing the cervical spine if needed.

**Step 3** Move the head and neck as a unit with the torso as your partner pulls on the distant shoulder and hip.

**Step 4** Move the patient to a supine position with legs straight and arms at the sides.

## Provide External Chest Compressions

Chest compressions are administered by applying rhythmic pressure and relaxation to the lower half of the sternum. The heart is located slightly to the left of the middle of the chest between the sternum and the spine Figure 11-7. Compressions squeeze the heart, thereby acting as a pump to circulate blood. When artificial ventilations are provided, the blood that is circulated through the lungs by chest compressions is likely to receive adequate oxygen to maintain tissue perfusion. However, even when external chest compressions are performed as proficiently as possible, they circulate only one third of the blood that is normally pumped by the heart, so it is very important to perform compressions properly.

Prior to administering external chest compressions, place the patient on a firm, flat surface, in a supine position. The patient's head should not be elevated at a level above the heart because this will further reduce blood flow to the brain. The surface can be the ground, the floor, or a backboard on a stretcher. You cannot perform chest compressions adequately on a bed; therefore, a patient who is in bed should be moved to the floor or have a board placed under the back.

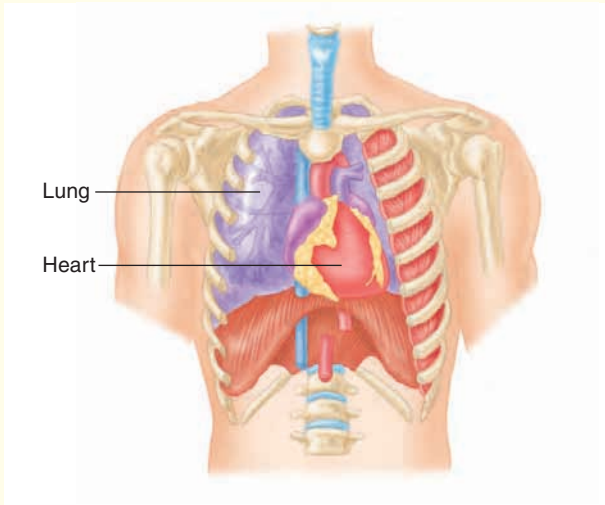



Figure 11-7 The heart lies slightly to the left of the middle of the chest between the sternum and spine.

## Proper Hand Position

Correct hand position is established by placing the heel of one hand on the sternum in the center of the chest (lower half of the sternum). Follow the steps in Skill Drill 11-2:

**Skill Drill 11-2**

1. Place the heel of one hand on the sternum in the center of the chest Step 1.
2. Place the heel of your other hand over the first hand Step 2.
3. With your arms straight, lock your elbows, and position your shoulders directly over your hands. Your technique may be improved or made more comfortable if you interlock the fingers of your lower hand with the fingers of your upper hand; either way, your fingers should be kept off the patient's chest.
4. Depress the sternum at least 2″ (in adults), using direct downward movement and then rising gently upward Step 3. It is important that you allow the chest to return to its normal position. Compression and relaxation should be of equal duration.

## Proper Compression Technique

Complications from chest compressions are rare but can include fractured ribs, a lacerated liver, and a fractured sternum. Although these injuries cannot be entirely avoided, you can minimize the chance that they will occur if you use good, smooth technique and proper hand placement.

Proper compressions begin by locking your elbows, with your arms straight, and positioning your shoulders directly over your hand so that the thrust of each compression is straight down on the sternum. Depress the sternum at least 2″ in an adult, avoiding a rocking motion and rising gently upward. This motion allows pressure to be delivered vertically down from your shoulders. Vertical downward pressure produces a compression that must be followed immediately by an equal period of relaxation. The ratio of time devoted to compression versus relaxation should be 1:1.

The actual motions must be smooth, rhythmic, and uninterrupted Figure 11-8A. Short, jabbing compressions are not effective in producing artificial blood flow. Do not remove the heel of your hand from the patient's chest during relaxation, but make sure that you completely release pressure on the sternum so that it can return to its normal resting position between compressions Figure 11-8B.

# Assessing Airway and Breathing

## Opening the Airway in Adults

Without an open airway, rescue breathing will not be effective. As discussed in Chapter 9, *Airway Management*, there are two techniques for opening the airway in adults: the head tilt–chin lift maneuver and the jaw-thrust maneuver. Open the airway with the head tilt–chin lift maneuver if there is no indication of a spinal injury. If spinal injury is suspected, use the jaw-thrust maneuver.

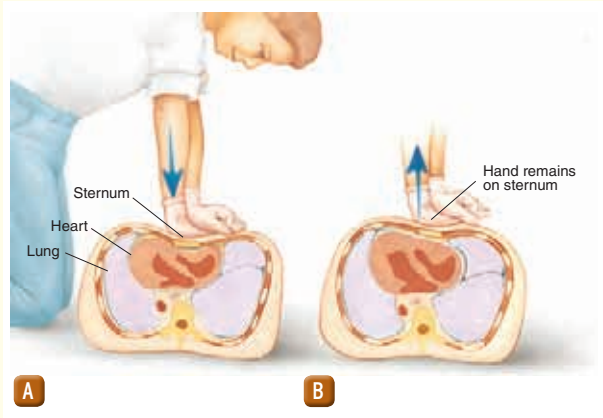



Figure 11-8 **A.** Compression and relaxation should be rhythmic and of equal duration. **B.** Pressure on the sternum must be released so that the sternum can return to its normal resting position between compressions. However, do not remove the heel of the hand from the sternum.

# Skill Drill 11-2

## Performing Chest Compressions

**Step 1** Place the heel of one hand on the center of the chest (lower half of the sternum).

**Step 2** Place the heel of your other hand over the first hand.

**Step 3** With your arms straight, lock your elbows, and position your shoulders directly over your hands. Depress the sternum at least 2″ using a direct downward movement. Allow the chest to return to its normal position. Compression and relaxation should be of equal duration.

Opening the airway to relieve an obstruction caused by relaxation of the tongue can often be accomplished quickly and easily with the **head tilt–chin lift maneuver** Figure 11-9. In patients who have not sustained trauma, this simple maneuver is sometimes all that is required for the patient to resume breathing. If the patient has any foreign material or vomitus in the mouth, you should quickly remove it. Wipe out any liquid materials from the mouth with a piece of cloth held by your index and middle fingers; use your hooked index finger to remove any solid material. Figure 11-10 reviews how to perform the head tilt–chin lift maneuver in an adult.

The head tilt–chin lift maneuver is effective for opening the airway in most patients. In patients with suspected spinal injury, you want to minimize movement of the patient's neck. In this case, perform a **jaw-thrust maneuver**. To perform a jaw-thrust maneuver, place your fingers behind the angles of the patient's lower jaw

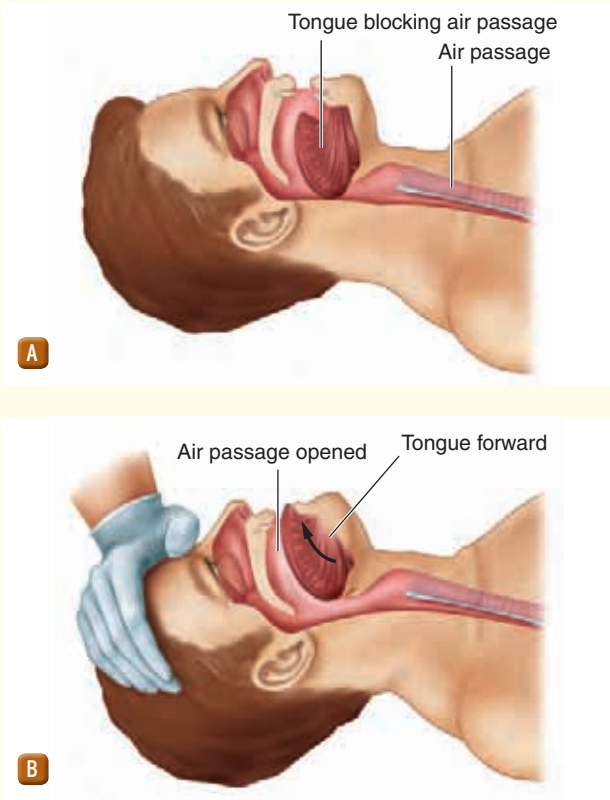



**Figure 11-9** **A.** Relaxation of the tongue back into the throat causes airway obstruction. **B.** The head tilt-chin lift maneuver combines two movements of opening the airway.

and then move the jaw upward. Keep the head in a neutral position as you move the jaw upward and open the mouth. If the patient's mouth remains closed, you can use your thumbs to pull the patient's lower lip down, to allow breathing. If the jaw thrust fails to open the airway, the head tilt–chin lift should be used to open the airway. An open airway is a primary goal when caring for trauma patients and must be attained to improve survival. **Figure 11-11** reviews how to perform the jaw-thrust maneuver.

## Recovery Position

If the patient is breathing on his or her own, and has no signs of trauma, you should place him or her in the recovery position. This position helps to maintain a clear airway in a patient with a decreased level of consciousness who has not sustained traumatic injuries and is breathing adequately on his or her own **Figure 11-12**. It also allows vomitus to drain from the mouth. Roll the patient onto his or her side so that the head, shoulders, and torso move as a unit, without twisting. Then place the top hand under his or her cheek. Never place a patient who has a suspected head or spinal injury in the recovery position because maintenance of spinal alignment in this position is not possible and further spinal cord injury could result.

**Figure 11-10** To perform the head tilt-chin lift maneuver, place one hand on the patient's forehead and apply firm backward pressure with your palm to tilt the head back. Next, place the tips of the index and middle fingers of your other hand under the lower jaw near the bony part of the chin. Lift the chin upward, bringing the entire lower jaw with it, helping to tilt the head back.

**Figure 11-11** To perform the jaw-thrust maneuver, maintain the head in neutral alignment and place your fingers behind the angles of the lower jaw, and move the jaw upward. The completed maneuver should look like this.

## Breathing

A lack of oxygen, combined with too much carbon dioxide in the blood, is lethal. To correct this condition, you must provide slow, deliberate ventilations that last 1 second. This gentle, slow method of ventilating the patient prevents air from being forced into the stomach.

Figure 11-12 The recovery position is used to maintain an open airway in an adequately breathing patient with a decreased level of consciousness who has had no traumatic injuries. It allows vomitus, blood, and any other secretions to drain from the mouth.

Figure 11-13 A barrier device is used in performing ventilation because it prevents exposure to saliva, blood, and vomitus.

## Provide Artificial Ventilations

Ventilations can be given by one or two EMS providers. A barrier device should be used when you are administering ventilations. In the prehospital environment, ventilations are routinely provided using barrier devices, such as a pocket mask or a bag-mask device. These devices feature a plastic barrier that covers the patient's mouth and nose and a one-way valve to prevent exposure to secretions and exhaled contaminants Figure 11-13. Such devices also provide good infection control. If a mask is not available, a face shield or some other type of physical barrier should be used. Providing ventilations without a barrier device should be performed only in extreme conditions. You should use devices that supply supplemental oxygen when possible. Devices that have an oxygen reservoir will provide higher percentages of oxygen to the patient. Regardless of whether you are ventilating the patient with or without supplemental oxygen, you should observe the chest for good rise to assess the effectiveness of your ventilations.

## You are the Provider: PART 2

You arrive at the scene and find two bystanders performing CPR on the patient, who appears to be in his late 40s. A second BLS ambulance is en route to the scene and will arrive in about 5 minutes. You perform a primary assessment as your partner opens the AED.

| Recording Time: 0 Minutes | |
|---|---|
| **Appearance** | Motionless; cyanosis to face |
| **Level of consciousness** | Unconscious and unresponsive |
| **Airway** | Open; clear of secretions or foreign bodies |
| **Breathing** | Absent |
| **Circulation** | No carotid pulse; skin, cool and pale; no gross bleeding |

Your partner takes over performing CPR. One of the bystanders tells you that the patient was about to get in his car when he suddenly grabbed his chest, slumped against the car, and eased himself to the ground. By the time the bystander got to him, he was unconscious and not breathing. The bystander further tells you that he immediately called 9-1-1 and then began CPR.

3. **What links in the chain of survival have been maintained at this point?**
4. **Why is it so critical to minimize interruptions in CPR?**

Ventilations need to be delivered at a rate and depth that is not excessive so as to not cause increased intrathoracic pressure. Increased intrathoracic pressure impedes venous return to the right side of the heart, thus decreasing the effectiveness of CPR because overall blood flow is reduced, resulting in the heart and brain receiving decreased amounts of oxygen.

You should perform rescue breathing in an adult with a simple barrier device in the following manner Figure 11-14:

1. Open the airway with the head tilt–chin lift maneuver (nontrauma patient).
2. Press on the forehead to maintain the backward tilt of the head. Pinch the patient's nostrils together with your thumb and index finger.
3. Depress the lower lip with the thumb of the hand that is lifting the chin. This will help to keep the patient's mouth open.
4. Open the patient's mouth widely, and place the barrier device over the patient's mouth and nose.
5. Take a deep breath, and then make a tight seal with your mouth around the barrier device. Give two slow rescue breaths, each lasting 1 second.
6. Remove your mouth, and allow the patient to exhale passively. Turn your head slightly to watch for movement of the patient's chest.

When using the jaw-thrust maneuver to open the airway (in suspected neck or spine injury), positioning yourself at the patient's head will facilitate simultaneous cervical spine stabilization and adequate ventilation. Keep the patient's mouth open with both thumbs, and seal the nose by placing your cheek against the patient's nostrils Figure 11-15. Note that this maneuver is somewhat difficult; practicing with a manikin will help you gain familiarity with this technique.

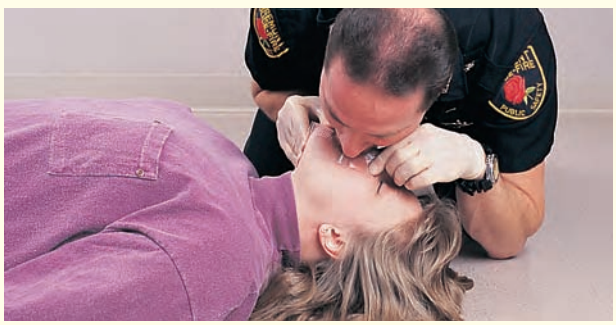


Figure 11-14 To perform ventilations, ensure that you make a tight seal with your mouth around the barrier device and then give two slow, gentle breaths, each lasting 1 second.

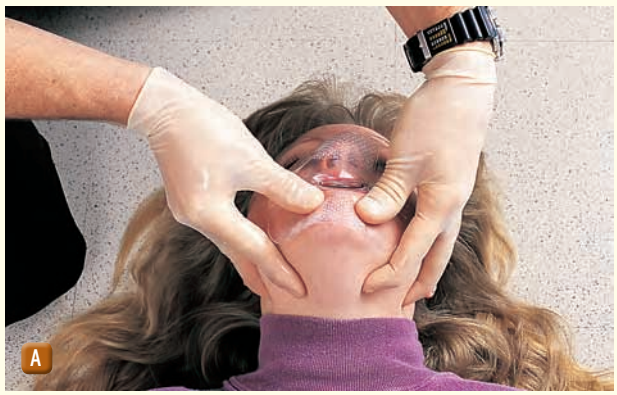




Figure 11-15 **A.** If you use the jaw-thrust maneuver to open the airway, keep the patient's mouth open with both thumbs as you move from above the patient's head to the side. **B.** Seal the nose by placing your cheek against the patient's nostrils.

### Words of Wisdom

Ventilation is the physical act of moving air in and out of the lungs. Ventilation is required for adequate respiration. If ventilation is adequate, other problems may hinder respiration. Examples of interruptions of ventilation include trauma such as flail chest, foreign body airway obstruction, and an injury to the spinal cord that disrupts the phrenic nerve that innervates the diaphragm.

## Stoma Ventilation

Patients who have undergone surgical removal of the larynx often have a permanent tracheal stoma at the midline in the neck. In this case, a stoma is an opening that connects the trachea directly to the skin Figure 11-16. Because it is at the midline, the stoma is the only opening that will move air into the patient's lungs; you should ignore any other openings. Patients with a stoma should be ventilated with a bag-mask device or pocket mask device directly over the stoma.

Not all stomas are disconnected from the nose and mouth. If air leakage through the nose and mouth



Figure 11-16 **A.** This stoma connects the trachea directly to the skin. **B.** Use a bag-mask device or pocket mask device to ventilate a patient with a stoma.

interferes with ventilation through the stoma, cover the nose and mouth with your hand. Use a pediatric or infant mask to ventilate through the stoma.

### Gastric Distention

Artificial ventilation may result in the stomach becoming filled with air, a condition called **gastric distention**. Although it occurs more easily in children, it also happens frequently in adults. Gastric distention is likely to occur if you ventilate too fast or with too much pressure as you ventilate. If you give too much air, or if the patient's airway is not opened adequately, the excess of gas opens up the collapsible tube, the esophagus, allowing gas to enter the stomach. Therefore, it is important for you to give slow, gentle breaths. Such breaths are also more effective in ventilating the lungs. Serious inflation of the stomach is dangerous because it can cause the patient to vomit during CPR. It can also reduce lung volume by elevating the diaphragm.

If massive gastric distention interferes with adequate ventilation, you should contact medical control. Check the airway again and reposition the patient, watch for rise and fall of the chest, and avoid giving forceful breaths. If gastric distention makes it impossible to ventilate the patient and paramedics are not available to perform orogastric or nasogastric tube decompression, medical control may order you to roll the patient on his or her side and provide gentle manual pressure to the abdomen to expel air from the stomach. Have suction readily available, and be prepared for copious amounts of vomitus.

## One-Rescuer Adult CPR

When you are providing CPR alone, you must give both artificial ventilations and chest compressions in a ratio of compressions to ventilations of 30:2. To perform one-rescuer adult CPR, follow the steps in Skill Drill 11-3:

### Skill Drill 11-3

1. Determine unresponsiveness and breathlessness and call for additional help Step 1.
2. Position the patient properly (supine) on a flat surface.
3. Determine pulselessness by checking the carotid pulse. Check the pulse for no more than 10 seconds Step 2.
4. If there is no pulse, begin CPR until an AED is available. Place your hands in the proper position for delivering external chest compressions, as described previously Step 3. Give 30 chest compressions at a rate of at least 100 per minute for an adult. Each set of 30 compressions should take about 17 seconds.
5. Open the airway according to your suspicion of spinal injury Step 4.
6. Give two ventilations of 1 second each and observe for visible chest rise Step 5.
7. Continue cycles of 30 chest compressions and two ventilations until additional personnel arrive or the patient starts to move.

## Two-Rescuer Adult CPR

You and your team should be able to perform one-rescuer and two-rescuer CPR with ease. Two-rescuer CPR is always preferable because it is less tiring and facilitates effective chest compressions. In fact, a team approach to CPR and AED use is far superior to the one-rescuer approach. Once one-rescuer CPR is in progress, additional rescuers can be added very easily. Prior to assisting

## Skill Drill 11-3

### Performing One-Rescuer Adult CPR

**Step 1** Determine unresponsiveness and breathlessness and call for help.

**Step 2** Check for a carotid pulse for no more than 10 seconds.

**Step 3** If there is no pulse, begin CPR until an AED is available. Give 30 chest compressions at a rate of at least 100 per minute.

**Step 4** Open the airway according to your suspicion of spinal injury.

with CPR, a second rescuer should apply the AED and then set up airway adjuncts including a bag-mask device and suction, and should insert an oral airway. If CPR is in progress, the second rescuer should enter the procedure after a cycle of 30 compressions and two ventilations. To perform two-rescuer adult CPR, follow the steps in Skill Drill 11-4:

## Skill Drill 11-4

1. Establish unresponsiveness and breathlessness as your partner moves to the patient's side to be ready to deliver chest compressions (Step 1).

## Skill Drill 11-3

### Performing One-Rescuer Adult CPR, continued

**Step 5** Give two ventilations of 1 second each and observe for visible chest rise. Continue cycles of 30 chest compressions and two ventilations until additional personnel arrive or the patient starts to move.

2. If the patient is unresponsive and not breathing, check the carotid pulse for no more than 10 seconds (Step 2). If the patient has no pulse and an AED is available, apply it now.
3. Begin CPR, starting with chest compressions. Give 30 chest compressions at a rate of at least 100 per minute (Step 3).
4. Open the airway according to your suspicion of spinal injury (Step 4).
5. Give two ventilations of 1 second each and observe for visible chest rise (Step 5).
6. Perform five cycles of 30 compressions and two ventilations (about 2 minutes). After 2 minutes of CPR, the compressor and ventilator should switch positions. The switch time should take no longer than 5 seconds.
7. Continue cycles of 30 chest compressions and two ventilations until ALS personnel take over or the patient starts to move.

## Switching Positions

Switching rescuers during CPR is beneficial to the quality of compressions administered to the patient. After five cycles of CPR (about 2 minutes), the rescuer providing compressions will begin to tire and compression quality will begin to suffer. It is therefore recommended to switch the rescuer doing compressions every 2 minutes. If there are only two rescuers, the rescuers will switch positions. If additional

## Skill Drill 11-4

### Performing Two-Rescuer Adult CPR

**Step 1** Determine unresponsiveness and breathlessness and take positions.

**Step 2** Check for a carotid pulse. If there is no pulse but an AED is available, apply it now.

**Step 3** Begin CPR, starting with chest compressions. Give 30 chest compressions at a rate of at least 100 per minute.

**Step 4** Open the airway according to your suspicion of spinal injury.

rescuers are available, rotating the rescuer providing compressions every five cycles (2 minutes) is required. During switches, every effort should be made to minimize the time that no compressions are being administered. This should be approximately 5 seconds but no more than 10 seconds of a break in between the compression cycle.

The switch between the two rescuers can be easily accomplished. Rescuer one should finish the cycle of 30 compressions while rescuer two moves to the opposite side of the chest and moves into position to begin compressions. Rescuer one should deliver two rescue breaths and then rescuer two should take over compressions by administering 30 chest compressions. Rescuer one will then deliver two ventilations and the CPR cycles will continue as needed until the next 2-minute mark (five cycles) is reached, at which time the process will be repeated.

## Skill Drill 11-4

### Performing Two-Rescuer Adult CPR, continued

**Step 5** Give two ventilations of 1 second each and observe for visible chest rise. Continue cycles of 30 chest compressions and two ventilations (switch roles every five cycles) until ALS personnel take over or the patient starts to move.

## Devices to Assist Circulation

The effectiveness of CPR is dependent on the amount of blood circulated throughout the body as a result of chest compressions. Even under ideal conditions, however, manual chest compressions cannot equate to normal cardiac output. In addition, factors such as rescuer fatigue or inaccurate depth or rate of compressions can further impede the resuscitation process.

Several mechanical devices are now available to assist emergency responders in delivering improved compressions when providing CPR. Although improved patient outcomes have not yet been documented, these devices may be considered for use as an adjunct to CPR when used by properly trained personnel for patients in cardiac arrest in the prehospital or in-hospital setting.

### Impedance Threshold Device

An impedance threshold device (ITD) is a valve device placed between the endotracheal tube and a bag-mask device. It is designed to limit the air entering the lungs during the recoil phase between chest compressions Figure 11-17. This results in negative intrathoracic pressure that draws more blood toward the heart, ultimately resulting in improved cardiac filling and circulation during each chest compression. It has been shown to improve short-term survival in adults when combined with other adjuncts to circulation in the management of a cardiac arrest. It has not been shown to improve long-term survival or the neurologic status of the patient.

**Figure 11-17** An impedance threshold device.

For use in a non-intubated patient, studies suggest that the ITD could be used with a face mask; however, a tight seal is essential to achieve the desired effect.

Although increased survival rates have not been proven, the use of ITDs may improve the effectiveness of CPR when used by trained rescuers.

## Mechanical Piston Device

A mechanical piston device is a device that depresses the sternum via a compressed gas-powered plunger mounted on a backboard Figure 11-18. The patient is positioned supine on the backboard, with the piston positioned on top of the patient with the plunger centered over the patient's thorax in the same manner as with manual chest compressions. The device is then secured to the backboard.

The device allows rescuers to configure the depth and rate of compressions, resulting in uniform delivery. This frees the rescuer to complete other tasks and eliminates rescuer fatigue that results from continuous delivery of manual chest compressions. These devices have been around for many years. The latest versions of these devices offer the provider the option of just providing compressions using a battery instead of an oxygen or compressed air system, thus eliminating the tanks and hoses.

## Load-Distributing Band CPR or Vest CPR

The load-distributing band (LDB) is a circumferential chest compression device composed of a constricting band and backboard Figure 11-19. The device is either electrically or pneumatically driven to compress the heart by putting inward pressure on the thorax.

As with the mechanical piston device, use of the device frees the rescuer to complete other tasks. The device is lighter than the early version mechanical piston devices and can be easier to apply. The end result is supposedly improved hemodynamics in the patient when used by properly trained emergency responders, though studies have demonstrated no improvement in short-term survival and worse neurologic outcome when the device was used. Further studies are needed.

Figure 11-18 A mechanical piston device.


Figure 11-19 A load-distributing band.

## Infant and Child CPR

In most cases, cardiac arrest in infants and children follows respiratory arrest, which triggers hypoxia and ischemia of the heart. Children consume oxygen two to three times as rapidly as adults. Therefore, you must first focus on opening an airway and providing artificial ventilation. Often, this will be enough to allow the child to resume spontaneous breathing and, thus, prevent cardiac arrest. Therefore, airway and breathing are the focus of pediatric basic life support (BLS) Table 11-1.

Respiratory problems leading to cardiopulmonary arrest in children can have a number of different causes, including:

- Injury, both blunt and penetrating
- Infections of the respiratory tract or another organ system
- A foreign body in the airway
- Submersion
- Electrocution
- Poisoning or drug overdose
- Sudden infant death syndrome

Pediatric BLS can be divided into four steps:

1. Determining responsiveness
2. Circulation
3. Airway
4. Breathing

Note that neonatal patients are defined as birth to age 1 month, and infants as age 1 month to 1 year. Neonatal resuscitation is covered in Chapter 31, *Obstetrics and Neonatal Care*.

**Table 11-1 Review of Pediatric BLS Procedures**

| Procedure | Infants (between age 1 month and 1 year[a]) | Children (1 year to onset of puberty[b]) |
|---|---|---|
| **Circulation** | | |
| Pulse check | Brachial artery | Carotid or femoral artery |
| Compression area | Just below the nipple line | In the center of the chest, in between the nipples |
| Compression width | Two fingers or two thumb encircling-hands technique | Heel of one or both hands |
| Compression depth | At least one third anterior-posterior diameter (about 1 1/2″) | At least one third anterior-posterior diameter (about 2″) |
| Compression rate | At least 100/min | At least 100/min |
| Compression-to-ventilation ratio (until advanced airway is inserted) | 30:2 (one rescuer); 15:2 (two rescuers)[c] | 30:2 (one rescuer); 15:2 (two rescuers)[c] |
| Foreign body obstruction | Responsive: Back slaps and chest thrusts<br>Unresponsive: CPR | Responsive: Abdominal thrust<br>Unresponsive: CPR |
| **Airway** | | |
| | Head tilt-chin lift; jaw thrust if spinal injury is suspected | Head tilt-chin lift; jaw thrust if spinal injury is suspected |
| **Breathing** | | |
| Ventilations | 1 breath every 3 to 5 seconds (12 to 20 breaths/min).<br>About 1 second per breath.<br>Visible chest rise. | 1 breath every 3 to 5 seconds (12 to 20 breaths/min.)<br>About 1 second per breath.<br>Visible chest rise. |

[a]The AHA defines neonatal patients as birth to age 1 month, and infants as age 1 month to 1 year. Neonatal resuscitation is covered in Chapter 31, *Obstetrics and Neonatal Care*.
[b]Onset of puberty is approximately 12 to 14 years of age, as defined by secondary characteristics (eg, breast development in girls and armpit hair in boys).
[c]Pause compressions to deliver ventilations.

## Determining Responsiveness and Breathing

Never shake a child to determine whether he or she is responsive, especially if there is the possibility of a neck or back injury. Instead, gently tap the child on the shoulder, and speak loudly Figure 11-20. If a child is responsive but struggling to breathe, allow him or her to remain in whatever position is most comfortable.

If you find an unresponsive, apneic, and pulseless child while you are alone and not on duty, perform CPR beginning with chest compressions for approximately five cycles (2 minutes), and then stop to call the EMS system. Why not call right away, as you would with an adult? Because, as mentioned previously, cardiopulmonary arrest in children is most often the result of respiratory failure, not a primary cardiac event. Therefore, they will require immediate restoration of oxygenation, ventilation, and circulation, which can be accomplished by immediately performing five cycles (about 2 minutes) of CPR before activating the EMS system.

## Circulation

After determining responsiveness and checking breathing, you need to assess circulation. As with an adult, you should first check for a palpable pulse in a large central artery. Absence of a palpable pulse in a major central artery means that you must begin external chest compressions. You can usually palpate the carotid or femoral pulse in children older than 1 year, but it is difficult in infants. Therefore, in infants, palpate the brachial artery, which is located on the inner side of the arm, midway between the elbow and shoulder. Place your thumb on the outer surface of the arm between the elbow and shoulder. Then place the tips of

**Figure 11-20** Never shake a child to determine responsiveness. Rather, gently tap on the shoulder (child) or tap the soles of the feet (infant), and speak loudly.

your index and middle fingers on the inside of the biceps, and press lightly toward the bone. Take at least 5 seconds but no more than 10 seconds to assess for a pulse. If the infant or child is not breathing, the pulse is often too slow (less than 60 beats/min) or absent altogether; therefore CPR will be required.

As with an adult, an infant or child must be lying on a hard surface for effective chest compressions. If you need to carry an infant while providing CPR, your forearm and hand can serve as the flat surface. Your palm should support the infant's head. In this way, the infant's shoulders are elevated, and the head is slightly tilted back in a position that will keep the airway open. However, you must ensure that the infant's head is not higher than the rest of the body.

The technique for chest compressions in infants and children differs because of a number of anatomic differences, including the position of the heart, the size of the chest, and the fragile organs of a child. The liver is relatively large, immediately under the right side of the diaphragm, and very fragile, especially in infants. The spleen, on the left, is much smaller and much more fragile in children than in adults. These organs are easily injured if you are not careful in performing chest compressions, so be sure that your hand position is correct before you begin. The chest of an infant is smaller and more pliable than that of an older child or adult; therefore, you should only use two fingers to compress the chest. In children, especially those older than 8 years of age, you can use the heel of one or both hands to compress the chest.

Follow these steps to perform infant chest compressions **Skill Drill 11-5**:

## You are the Provider: PART 3

With CPR ongoing, you open the AED pads and prepare to apply them to the patient's chest. You note that the patient has a medication patch on the right upper part of his chest. You also see a bulge with a scar over it on the left upper part of his chest. You apply the AED pads, analyze the patient's cardiac rhythm, and receive a "shock advised" message. After delivering the shock, you and your partner resume CPR. The backup ambulance arrives and one of the EMTs assesses the quality of your CPR.

| Recording Time: 4 Minutes | |
|---|---|
| **Level of consciousness** | Unconscious and unresponsive |
| **Respirations** | Absent (baseline); two breaths are being given after every 30 chest compressions; chest rise is visible with each breath |
| **Pulse** | Absent (baseline); femoral pulse is palpable with chest compressions |
| **Skin** | Pale |
| **Blood pressure** | Not measurable |
| **Oxygen saturation ($Sao_2$)** | Not measurable |

5. Should you remove the medication patch or leave it in place? Why or why not?
6. What does the bulge and scar over the patient's chest indicate? How will this affect the way you treat the patient?

## Skill Drill 11-5

1. Place the infant on a firm surface, using one hand to keep the head in an open airway position. You can also use a pad or wedge under the shoulders and upper body to keep the head from tilting forward.
2. Imagine a line drawn between the nipples. Place two fingers in the middle of the sternum, just below the nipple line (Step 1).
3. Using two fingers, compress the sternum about one third the anterior-posterior diameter of the chest (approximately 1½″ in most infants). Compress the chest at a rate of at least 100 per minute.
4. After each compression, allow the sternum to return briefly to its normal position. Allow equal time for compression and relaxation of the chest. Do not remove your fingers from the sternum, and avoid jerky movements (Step 2).

Coordinate rapid compressions and ventilations in a 30:2 ratio if working alone, and 15:2 if working with another health care provider, making sure the infant's chest fully recoils in between compressions and that the chest visibly rises with each ventilation. You will find this easier to do if you use your free hand to keep the head in the open airway position. If the chest does not rise, or rises only a little, use a chin lift to open the airway. Reassess the infant for signs of spontaneous breathing or a pulse after five cycles (about 2 minutes) of CPR.

Skill Drill 11-6 shows the steps for performing CPR in children between 1 year of age and the onset of puberty:

## Skill Drill 11-6

1. Place the child on a firm surface. Place the heel of one or two hands in the center of the chest, in between the nipples. Avoid compression over the lower tip of the sternum, which is called the xiphoid process (Step 1).
2. Compress the chest about one third the anterior-posterior diameter of the chest (approximately 2″ in most children) at a rate of at least 100 per minute. With pauses for ventilation, the actual number of compressions delivered will be about 80 per minute. In between compressions, allow the chest to fully recoil. Compression and relaxation time should be the same duration. Use smooth movements. Hold your fingers off the child's ribs, and keep the heel of your hand(s) on the sternum.

## Skill Drill 11-5

### Performing Infant Chest Compressions

**Step 1** Position the infant on a firm surface while maintaining the airway. Place two fingers in the middle of the sternum with one finger touching the nipple line.

**Step 2** Use two fingers to compress the chest one third to one half its depth at a rate of at least 100 per minute. Allow the sternum to return to its normal position between compressions.

3. Coordinate rapid compressions and ventilations in a 30:2 ratio for one rescuer and 15:2 for two rescuers, making sure the chest rises with each ventilation. At the end of each cycle, pause for two ventilations (Step 2).
4. After five cycles (about 2 minutes) assess for signs of breathing or a pulse. If there is no pulse and you have an AED, apply it now.
5. If the child regains a pulse of greater than 60 beats/min and resumes effective breathing, place him or her in a position that allows for frequent reassessment of the airway and vital signs during transport (Step 3).

Switching rescuer positions is the same for children as it is for adults, every five cycles (2 minutes) of CPR.

Remember, if the child is past the onset of puberty, use the adult CPR sequence, including the use of the AED.

## Skill Drill 11-6

### Performing CPR on a Child

**Step 1** Place the child on a firm surface. Place the heel of one or both hands in the center of the chest, in between the nipples, avoiding the xiphoid process.

**Step 2** Compress the chest about one third the anterior-posterior diameter of the chest at a rate of at least 100 times/min. Coordinate compressions with ventilations in a 30:2 ratio (one rescuer) or 15:2 (two rescuers), pausing for ventilations.

**Step 3** If there is no pulse, apply your AED. If the child regains a pulse of greater than 60 beats/min and resumes effective breathing, place him or her in a position that allows for frequent reassessment of the airway and vital signs during transport.

## Airway

Children (infants and toddlers) often put toys and other objects, as well as food, in their mouths; therefore, foreign body obstruction of the upper airway is common. You must make sure that the upper airway is open when managing pediatric respiratory emergencies or cardiopulmonary arrest. If the child is unresponsive and lying in a supine position, the airway may become obstructed when the tongue and throat muscles relax and the tongue falls backward.

If the child is unresponsive but breathing adequately, place him or her in the recovery position to maintain an open airway and allow drainage of saliva, vomitus, or other secretions from the mouth Figure 11-21. Do not use this position if you suspect a spinal injury unless you can secure the child to a backboard that can be tilted to the side. Do not attempt to open the airway at all if the child is responsive and breathing, but in a labored fashion. Instead, provide immediate transport to the nearest hospital.

Opening the airway in an infant or child is done by using the same techniques as used for an adult. However, because a child's neck is so flexible, the techniques should be slightly modified. The jaw-thrust maneuver without a head tilt is the best method to use if you suspect a spinal injury in a child. If a second rescuer is present, he or she should immobilize the child's cervical spine. If spinal injury is not suspected, use the head tilt–chin lift maneuver but modified so that, as you tilt the head back, you are moving it only into the neutral position or a slightly extended position Figure 11-22.

### Head Tilt-Chin Lift Maneuver

Perform the head tilt-chin lift technique in a child in the following manner:

1. Place one hand on the child's forehead, and tilt the head back gently, with the neck slightly extended.
2. Place two or three fingers (not the thumb) of your other hand under the child's chin, and lift the jaw upward and outward. Do not close the mouth or push under the chin; either move may obstruct rather than open the airway.
3. Remove any visible foreign body or vomitus.

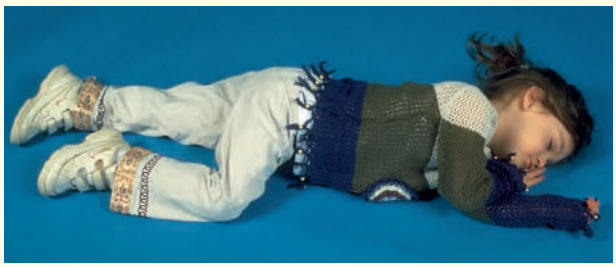


Figure 11-21 A child who is unconscious but breathing should be placed in the recovery position to allow saliva or vomitus to drain from the mouth.

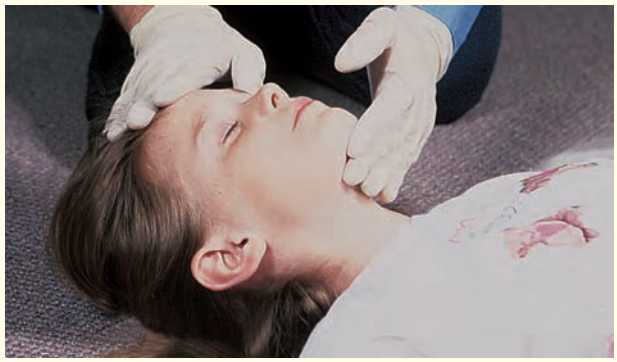


Figure 11-22 Use the head tilt-chin lift maneuver to open the airway in a child who has not sustained a traumatic injury. Do not overextend the neck.

### Jaw-Thrust Maneuver

Perform the jaw-thrust maneuver in a child in the following manner:

1. Place two or three fingers under each side of the angle of the lower jaw; lift the jaw upward and outward.
2. If the jaw thrust alone does not open the airway and cervical spine injury is not a consideration, tilt the head slightly. If cervical spine injury is suspected, use a second rescuer to immobilize the cervical spine.

Remember that the head of an infant or young child is disproportionately large in comparison with the chest and shoulders. As a result, when a child is lying flat on his or her back, especially on a backboard, the head will bend forward (hyperflexion) onto the upper chest. This position can partially or completely obstruct the upper airway. To avoid this possibility, place a wedge of padding under the child's upper chest and shoulders (torso).

## Provide Rescue Breathing

Once the airway is open, take at least 5 seconds but no more than 10 seconds to determine whether the child is breathing spontaneously Figure 11-23.

If an infant or small child is breathing, provide immediate transport. Again, a child who is in respiratory distress should be allowed to stay in whatever position is most comfortable. Larger children who are unresponsive and breathing with difficulty should be kept in the recovery position if possible.

If an infant or child is not breathing but has a pulse, provide rescue breathing while keeping the airway open. If you are using mouth-to-mouth resuscitation with an infant,

**Figure 11-23** After you have opened the airway, determine whether the child is breathing spontaneously.

place your mouth over the infant's mouth and nose to create a seal. If you are using a bag-mask device to assist ventilations in an infant, use the proper sized mask and the technique described earlier.

In a child with tracheostomy (breathing) tubes in the neck, remove the mask from the bag-mask device and connect it directly to the tracheostomy tube to ventilate the child. If a bag-mask device is unavailable, a mask, barrier device, or your mouth over the tracheostomy site can be used. Place your hand firmly over the child's mouth and nose to prevent the artificial breaths from leaking out of the upper airway.

### Words of Wisdom

An injured child with serious airway or breathing problems is likely to need full-time attention from two EMTs. The need for a driver, and often for added help with patient care, makes it important for you to start arranging early for backup from another unit—possibly even before you arrive at the scene.

### Words of Wisdom

AEDs are becoming more and more accessible in the community. Be familiar with your local protocols on pediatric defibrillation. Your service may use a pediatric AED or an AED with a pediatric adapter.

## Interrupting CPR

CPR is an important holding action that provides minimal circulation and ventilation until the patient can receive definitive care in the form of defibrillation or further care at the hospital. No matter how well CPR is performed, however, it is rarely enough to save a patient's life. If ALS is not available at the scene, you must provide transport based on your local protocols, continuing CPR on the way. En route to the hospital, you should consider requesting a rendezvous with ALS personnel, if available. This will provide ALS care to the patient earlier, improving his or her chance for survival. Note however, that not all EMS systems have ALS support available to them, especially in rural settings.

Try not to interrupt CPR for more than a few seconds, except when it is absolutely necessary. For example, if you have to move a patient up or down stairs, you should continue CPR until you arrive at the head or foot of the stairs, interrupt CPR at an agreed-on signal, and move quickly to the next level where you can

### Special Populations

Children in respiratory distress are often struggling to breathe. As a result, they usually position themselves in a way that keeps the airway open enough for air to move. Let the child stay in that position as long as his or her breathing remains adequate. If you and your partner arrive at the scene and find that the infant or child is not breathing or has cyanosis, immediate management, including rescue breathing and supplemental oxygen, is essential. Consider requesting additional assistance, if available.

For infants, the preferred technique of rescue breathing is mouth-to-nose-and-mouth ventilation. With this technique, a seal must be made over the mouth and nose. Various masks and other barrier devices are recommended for this technique. If the patient is a large child (1 to 8 years old) for whom a tight seal cannot be made over both mouth and nose, you should provide mouth-to-mouth ventilation as you would for an adult.

Once you have made an airtight seal over the mouth, give two gentle breaths, each lasting 1 second. These initial breaths will help you assess for airway obstruction and expand the lungs. Because the lungs of infants and children are much smaller than those of adults, you do not need to blow in a large amount of air. Limit the amount of air to that needed to cause the chest to rise.

Remember, too, that a child's airway is smaller than that of an adult. Therefore, there is greater resistance to air flow. As a result, you will need to use slightly more ventilatory pressure to inflate the lungs. You will know you are giving the correct amount of air volume when you see the chest rise. Infants and children should be ventilated once every 3 to 5 seconds, or 12 to 20 breaths/min.

If air enters freely with your initial breaths and the chest rises, the airway is clear. You should then check the pulse. If air does not enter freely, you should check the airway for obstruction. Reposition the patient to open the airway, and attempt to give another breath. If air still does not enter freely, you must take steps to relieve the obstruction.

resume CPR. Do not move the patient until all transport arrangements are made so that your interruptions of CPR can be kept to a minimum.

## When Not to Start BLS

As an EMT, it is your responsibility to start CPR in virtually all patients who are in cardiac arrest. There are only two general exceptions to the rule.

First, you should not start CPR if the patient has obvious signs of death. Obvious signs of death include an absence of a pulse and breathing, along with any one of the following findings:

- Rigor mortis, or stiffening of the body after death
- Dependent lividity (livor mortis), a discoloration of the skin caused by pooling of blood Figure 11-24
- Putrefaction or decomposition of the body
- Evidence of nonsurvivable injury, such as decapitation, dismemberment, or burned beyond recognition.

Rigor mortis and dependent lividity develop after a patient has been dead for a long period.

Second, you should not start CPR if the patient and his or her physician have previously agreed on do not resuscitate (DNR) orders or no-CPR orders Figure 11-25. This may apply only to situations in which the patient is known to be in the terminal stage of an incurable disease. In this situation, CPR serves only to prolong the patient's death. However, this can be a complicated issue. Advance directives, such as living wills, may express the patient's wishes; however, these documents may not be readily producible by the patient's family or caregiver.

Figure 11-24 Dependent lividity is an obvious sign of death, caused by blood settling to the areas of the body not in firm contact with the ground. The lividity in this figure is seen as purple discoloration of the back, except in areas that are in firm contact with the ground (scapula and buttock).

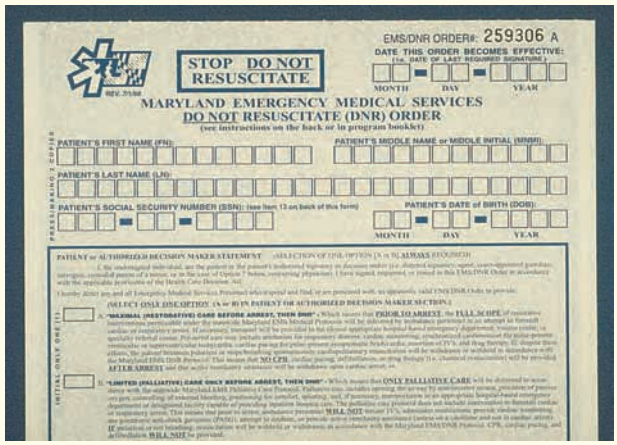



Figure 11-25 You should not start CPR if the patient and his or her physician have previously agreed on DNR or no-CPR orders. Learn your local protocols for treating terminally ill patients.

In such cases, the safest course is to assume that an emergency exists and begin CPR under the rule of implied consent and contact medical control for further guidance. Conversely, if a valid DNR document or living will is produced, resuscitative efforts may be withheld. Learn your local protocols and the standards in your system for treating terminally ill patients. Some EMS systems have computer notes on patients who are preregistered with the system. These notes usually specify the amount and extent of treatment that is desired. Other states have specific EMS DNR forms that allow EMS providers to withhold care when the patient, family, and physician have agreed in advance that such a course is most appropriate. It is essential that you understand your local protocols and are aware of the specific restrictions these advance directives imply.

In all other cases, you should begin CPR on anyone who is in cardiac arrest. It is usually impossible to know how long the patient has been without oxygen to the brain and vital organs. Factors such as air temperature and the basic health of the patient's tissues and organs can affect their ability to survive. Therefore, most legal advisers recommend that, when in doubt, always give too much care rather than too little care. You should always start CPR if any doubt exists.

## When to Stop BLS

You are not responsible for making the decision to stop CPR. Once you begin CPR in the field, you must continue until one of the following events occurs:

**S** The patient *Starts* breathing and has a pulse.
**T** The patient is *Transferred* to another person who is trained in BLS, to ALS-trained personnel, or to another emergency medical responder.
**O** You are *Out* of strength or too tired to continue.
**P** A *Physician* who is present or providing online medical direction assumes responsibility for the patient and gives direction to discontinue CPR.

"Out of strength" does not mean merely weary; rather, it means that the person providing CPR is no longer physically able to perform CPR. In short, CPR should always be continued until the patient's care is transferred to a physician or higher medical authority in the field. In some cases, your medical director or a designated medical control physician may order you to stop CPR on the basis of the patient's condition.

Every EMS system should have clear standing orders or protocols that provide guidelines for starting and stopping CPR. Your medical director and your system's legal adviser should agree on these protocols, which should be closely administered and reviewed by your medical director.

### Words of Wisdom

Correct handling of situations when you choose not to start CPR on a patient in cardiac arrest begins with compliance with your protocols and ends with you providing detailed documentation. In particular, record physical examination signs that led to your decision and make reference to the protocol that states these signs are a reason not to start. If extenuating circumstances such as entrapment physically prevent you from making resuscitation attempts, record the conditions thoroughly. These decisions occasionally give rise to questions that can often be put to rest immediately with reference to a well-written report.

## Foreign Body Airway Obstruction in Adults

Occasionally, a large foreign body will be aspirated and block the upper airway. An airway obstruction may be caused by various things, including relaxation of the throat muscles in an unconscious patient, vomited or regurgitated stomach contents, blood, damaged tissue after an injury, dentures, or foreign bodies such as food or small objects.

Large objects that cannot be removed from the airway with suction, such as loose dentures, large pieces of food, or blood clots, should be swept forward and out with your gloved index finger. Suctioning can then be used as needed to keep the airway clear of thinner secretions such as blood, vomitus, and mucus.

## Recognizing Foreign Body Airway Obstruction

An airway obstruction by a foreign body in an adult usually occurs during a meal. In children, it usually occurs during mealtime or at play. Children commonly choke on peanuts, large bits of a hot dog, or small toys. If the foreign body is not removed quickly, the lungs will use up their oxygen supply and unconsciousness and death will follow. Treatment is based on the severity of airway obstruction the patient is experiencing.

### Mild Airway Obstruction

Patients with a mild (partial) airway obstruction are able to exchange adequate amounts of air, but still have signs of respiratory distress. Breathing may be noisy; however, the patient usually has a strong, effective cough. Leave these patients alone! Your main concern is to prevent a mild airway obstruction from becoming a severe airway obstruction. The abdominal thrust is not indicated in patients with a mild airway obstruction.

For the patient with a mild airway obstruction, you should first encourage him or her to cough or to continue coughing if they are already doing so. Do not interfere with the patient's own attempts to expel the foreign body. Instead, give 100% oxygen with a nonrebreathing mask and provide prompt transport to the hospital. Closely monitor the patient and observe for signs of a severe airway obstruction (weak or absent cough, decreasing level of consciousness, cyanosis).

### Conscious Patients

A sudden, severe airway obstruction is usually easy to recognize in someone who is eating or has just finished eating. The person is suddenly unable to speak or cough, grasps his or her throat, turns cyanotic, and makes exaggerated efforts to breathe. Air is not moving into and out of the airway or the air movement is so slight that it is not detectable. At first, the patient will be conscious and able to clearly indicate the nature of the problem. Ask the patient, "Are you choking?" The patient will usually answer by nodding yes. Alternatively, he or she may use the universal sign to indicate airway blockage Figure 11-26.

If there is a minimal amount of air movement, you may hear a high-pitched sound called stridor. This occurs when the object is not fully occluding the airway, but the small amount of air entering the lungs is not enough to sustain life and the patient will eventually lose consciousness if the obstruction is not relieved.

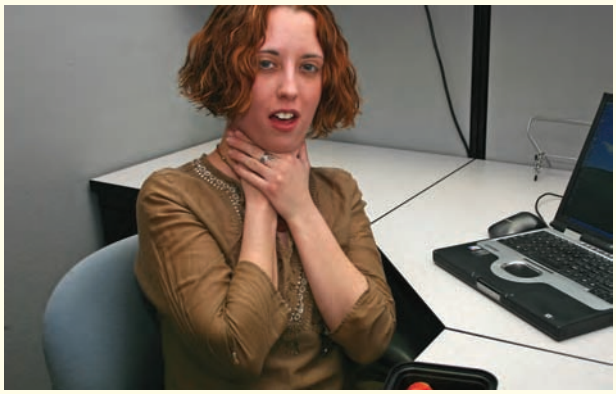


**Figure 11-26** Hands at the throat is the universal sign to indicate choking.

### Unconscious Patients

When you discover an unconscious patient, your first step is to determine whether he or she is breathing and has a pulse. The unconsciousness may be caused by airway obstruction, cardiac arrest, or a number of other problems. Remember that you must first clear the patient's airway, making sure it is open and unobstructed, before checking for a pulse and addressing other problems, such as cardiac arrest.

You should suspect an airway obstruction if the standard maneuvers to open the airway and ventilate the lungs are not effective. If you feel resistance to blowing into the patient's lungs or pressure builds up in your mouth, the patient probably has some type of obstruction.

## Removing a Foreign Body Airway Obstruction in an Adult

The manual maneuver recommended for removing severe airway obstructions in conscious adults and children older than 1 year of age is the abdominal-thrust maneuver (the Heimlich maneuver). This technique creates an artificial cough by causing a sudden increase in intrathoracic pressure when thrusts are applied to the subdiaphragmatic region; it is a very effective method for removing a foreign body that is obstructing the airway.

### Conscious Patients

**Abdominal-Thrust Maneuver** The abdominal-thrust maneuver, also called the Heimlich maneuver, is the preferred way to dislodge a severe airway obstruction in conscious adults and children older than 1 year of age. The goal is to compress the lungs upward and force the residual air, which is always present in the lungs, to flow upwards and expel the object. In conscious patients with a severe airway obstruction, you should repeat abdominal thrusts until the foreign body is expelled or the patient becomes unconscious. Each thrust should be deliberate, with the intent of relieving the obstruction.

## You are the Provider: PART 4

After 2 minutes of CPR, you reanalyze the patient's cardiac rhythm and receive a "no shock advised" message. You and your partner immediately resume CPR. During CPR, your partner ventilates the patient with a bag-mask device and high-flow oxygen. As she attempts to insert an oral airway, the patient starts to gag. You quickly reassess him.

| Recording Time: 7 Minutes | |
|---|---|
| **Level of consciousness** | Unconscious and unresponsive |
| **Respirations** | Occasional agonal breaths; 4 breaths/min |
| **Pulse** | 100 beats/min; strong carotid pulse; absent radial pulses |
| **Skin** | Skin color is improving |
| **Blood pressure** | 70/40 mm Hg |
| **$Sao_2$** | 82% (on oxygen) |

7. How should you continue to treat this patient?
8. Because the patient is no longer in cardiac arrest, should you remove the AED pads? Why or why not?

To perform abdominal thrusts on a conscious adult Figure 11-27, use the following technique:

1. Stand behind the patient, and wrap your arms around his or her abdomen. Straddle your legs outside the patient's legs. This will allow you to easily slide the patient to the ground in the event he or she becomes unconscious.
2. Make a fist with one hand; grasp the fist with the other hand. Place the thumb side of the fist against the patient's abdomen just above the umbilicus.
3. Press your fist into the patient's abdomen with a quick inward and upward thrust.
4. Continue abdominal thrusts until the object is expelled from the airway or the patient becomes unconscious.

**Chest Thrusts** You can perform the abdominal-thrust maneuver safely on all adults and children. However, for women in advanced stages of pregnancy and patients who are very obese, you should use chest thrusts instead.

To perform chest thrusts on the conscious adult, use the following technique Figure 11-28:

1. Stand behind the patient with your arms directly under the patient's armpits, and wrap your arms around the patient's chest.
2. Make a fist with one hand; grasp the fist with the other hand. Place the thumb side of the fist against the patient's sternum, avoiding the xiphoid process and the edges of the rib cage.
3. Press your fist into the patient's chest with backward thrusts until the object is expelled or the patient becomes unconscious.

**Figure 11-27** The abdominal-thrust maneuver in a conscious adult. Stand behind the patient and wrap your arms around the patient's abdomen. Place the thumb side of one fist against the patient's abdomen while holding your fist with your other hand. Press your fists into the patient's abdomen, using inward and upward thrusts.

**Figure 11-28** Removal of a foreign body obstruction in a conscious adult using chest thrusts. Stand behind the patient and wrap your arms around the patient's chest. Place the thumb side of one fist against the chest while holding your fist with your other hand. Press your fists into the patient's chest with backward thrusts.

4. If the patient becomes unconscious, you should begin CPR, starting with chest compressions Figure 11-29.

**Words of Wisdom**

If a conscious choking patient is found lying on the floor, abdominal thrusts can be administered by straddling the patient's legs, placing your hands just above the umbilicus, and giving rapid thrusts inward and upward under the rib cage, using the palm of your hand with your other hand on top of it.

## Conscious Patients Who Become Unconscious

A patient with an airway obstruction may become unconscious and require additional care. Knowing that the patient had an obstruction should prompt you to open the airway and look for an obstruction before completing the additional steps of resuscitation. Use the following steps to manage the patient:

1. Open the patient's airway.
2. Look in the patient's mouth. If you see the foreign object, remove it. If an object is not seen, begin CPR compressions.
3. Assess for breathing.

Figure 11-29 An unconscious patient with an airway obstruction requires CPR.

4. If the patient is not breathing, attempt to give one ventilation. If the air does not go in, reposition the patient's head and attempt one more ventilation.
5. If the air still does not go in, give 30 chest compressions.
6. Look in the patient's mouth to see if you can visualize the object. If you see the object, remove it. If not, attempt to ventilate.
7. Continue steps 4 and 5 until the object is removed and air flow is established. Once you can successfully ventilate the patient, check for a pulse. If there is no pulse, begin CPR with compressions.

### Unconscious Patients

When a victim is found unconscious, it is unlikely that you will know what caused the problem. Begin the steps of CPR by determining unresponsiveness and beginning chest compressions. Perform 30 chest compressions and then open the airway and look in the mouth. If an object is visible, attempt to remove it. Never perform blind finger sweeps on any patient; doing so may push the obstruction further into the airway. After opening the airway and looking inside the mouth, reattempt to ventilate the patient. Continue the process of chest compressions, opening the airway, looking inside the mouth, and attempting to ventilate until the airway is clear or advanced life support help arrives.

**Words of Wisdom**

It is likely that if you find an unresponsive victim you will not know whether choking was the initial cause. Begin the steps of CPR and assess during the breathing phase to determine if there is good air flow by looking at chest rise. If the chest does not rise, reposition the airway, look inside the mouth, and ventilate again.

## Foreign Body Airway Obstruction in Infants and Children

Airway obstruction is a common problem in infants and children. It is usually caused by a foreign body such as food or a toy, or by an infection, such as croup or epiglottitis, resulting in swelling and narrowing of the airway. You should try to identify the cause of the obstruction as soon as possible. In patients who have signs and symptoms of an airway infection, you should not waste time trying to dislodge a foreign body. The child needs 100% oxygen with a nonrebreathing mask and immediate transport to the emergency department.

A previously healthy child who is eating or playing with small toys or an infant who is crawling about the house and who suddenly has difficulty breathing has probably aspirated a foreign body. As in adults, foreign bodies may cause a mild or a severe airway obstruction.

With a mild airway obstruction, the patient can cough forcefully, although there may be wheezing between coughs. As long as the patient can breathe, cough, or talk, you should not interfere with his or her attempts to expel the foreign body. As with the adult, encourage the child to continue coughing. Administer 100% oxygen with a nonrebreathing mask (if tolerated) and provide transport to the emergency department.

You should intervene only if signs of a severe airway obstruction develop, such as a weak, ineffective cough, cyanosis, stridor, absent air movement, or a decreasing level of consciousness.

## Removing a Foreign Body Airway Obstruction in a Child

### Conscious Child

If you determine a child older than 1 year has an airway obstruction, stand or kneel behind the child and provide abdominal thrusts in the same manner as an adult, but use less force, until the object is expelled or the child becomes unconscious. If the child becomes unconscious, follow the same steps as for the unconscious adult.

To perform the abdominal-thrust maneuver in a conscious child who is in a standing or sitting position, follow these steps Figure 11-30:

1. Kneel on one knee behind the child, and circle both of your arms around the child's body. Prepare to give abdominal thrusts by placing your fist just above the patient's umbilicus and well below the lower tip of the sternum. Place your other hand over that fist.
2. Give the child abdominal thrusts in an upward direction. Be careful to avoid applying force to the lower rib cage or sternum.

**Figure 11-30** To perform the abdominal-thrust maneuver, kneel behind the child, wrap your arms around his or her body, and place your fist just above the umbilicus and well below the lower tip of the sternum.

3. Repeat this standing technique until the child expels the foreign body or loses consciousness.
4. If the child becomes unconscious, position the child on a hard surface. Open the airway using the head tilt–chin lift maneuver and look inside the child's mouth. If you can see the foreign body, try to remove it.
5. Attempt rescue breathing. If the first attempt fails, reposition the head and try again.
6. If the airway remains obstructed, begin CPR starting with chest compressions.

If you manage to clear the airway obstruction in an unconscious child but he or she still has no spontaneous breathing or circulation, perform CPR.

## Unconscious Child

An unconscious child older than 1 year who has an airway obstruction is managed in the same manner as an adult. **Skill Drill 11-7** demonstrates the steps for removing a foreign body airway obstruction in an unconscious child:

### Skill Drill 11-7

1. Place the child in a supine position on a firm, flat surface (Step 1).
2. Open the airway using the head tilt–chin lift maneuver and look inside the child's mouth for the obstruction (Step 2).
3. Attempt rescue breathing. If the first try is unsuccessful, reposition the child's head and try again (Step 3).
4. If ventilation is still unsuccessful, begin CPR (Step 4).

## You are the Provider: PART 5

You package the patient, load him into the ambulance, and begin transport to a hospital located 5 miles away. An EMT from the backup ambulance accompanies you in the back and continues rescue breathing. En route, you reassess the patient and then call your radio report to the receiving hospital.

| Recording Time: 12 Minutes | |
|---|---|
| **Level of consciousness** | Unconscious and unresponsive |
| **Respirations** | 8 breaths/min; shallow depth |
| **Pulse** | 94 beats/min; strong carotid pulse, weak radial pulses |
| **Skin** | Pink, cool, and dry |
| **Blood pressure** | 86/66 mm Hg |
| **$Sao_2$** | 95% (on oxygen) |

9. Would an impedance threshold device benefit your patient at this point?
10. What further treatment is indicated for this patient?

5. Place the heel of one hand on the center of the chest (lower half of the sternum).
6. Administer 30 chest compressions. Compressions should be one third to one half the depth of the chest.
7. Open the airway using the head tilt–chin lift maneuver and look inside the child's mouth. If you see the object, remove it Step 5.
8. Repeat the process starting at Step 3.

## Removing a Foreign Body Airway Obstruction in Infants

### Conscious Infants

Abdominal thrusts are not recommended for conscious infants with an airway obstruction because of the risk of injury to the immature organs of the abdomen. Instead, perform back slaps and chest thrusts to try to clear a severe airway obstruction in a conscious infant, as follows Figure 11-31:

1. Hold the infant face down, with the body resting on your forearm. Support the infant's jaw and face with your hand, and keep the head lower than the rest of the body.
2. Deliver five back slaps between the shoulder blades, using the heel of your hand.
3. Place your free hand behind the infant's head and back, and turn the infant face up on your other forearm and thigh, sandwiching the infant's body between your two hands and arms. The infant's head should remain below the level of the body.
4. Give five quick chest thrusts in the same location and manner as chest compressions, using two fingers placed on the lower half of the sternum. For larger infants, or if you have small hands, you can perform this step by placing the infant in your lap and turning the infant's whole body as a unit between back slaps and chest thrusts.
5. Check the airway. If you can see the foreign body now, remove it. If not, repeat the cycle as often as necessary.
6. If the infant becomes unconscious, begin CPR, remembering to look in the airway before ventilations each time.

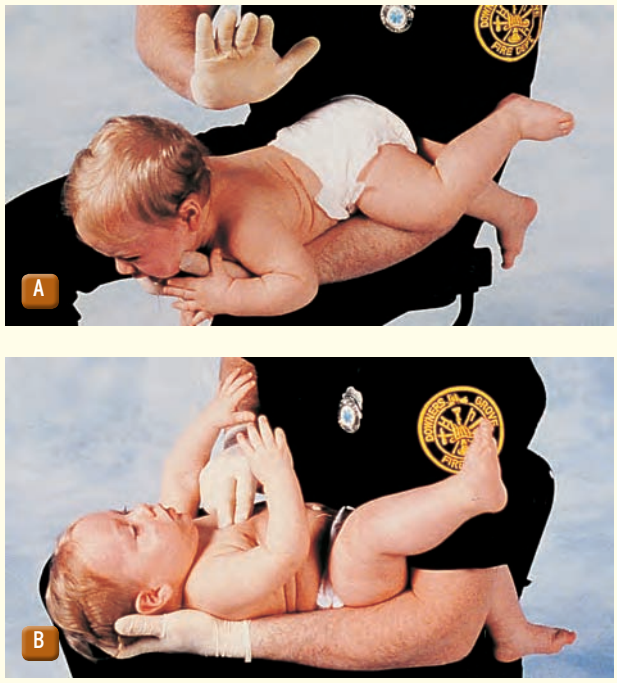



**Figure 11-31** **A.** Hold the infant face down with the body resting on your forearm. Support the jaw and face with your hand, and keep the head lower than the rest of the body. Give the infant five back slaps between the shoulder blades, using the heel of your hand. **B.** Give the infant five quick chest thrusts, using two fingers placed on the lower half of the sternum.

As with the adult and child, if the infant loses consciousness, look inside the mouth. If you see the object, remove it. If not, begin CPR with 30 compressions. If there is no pulse, or the pulse is less than 60 beats per minute, continue the process of compressions, looking in the mouth, and attempting ventilations until the obstruction is relieved and then assess for a pulse.

### Unconscious Infants

Begin CPR but include one extra step: Look inside the infant's airway each time before ventilating and remove the object if seen.

# Skill Drill 11-7

## Removing a Foreign Body Airway Obstruction in an Unconscious Child

**Step 1** Position the child on a firm, flat surface.

**Step 2** Open and inspect the airway. Remove any foreign object that you can see.

**Step 3** Attempt rescue breathing. If unsuccessful, reposition the head and try again.

**Step 4** If ventilation is still unsuccessful, begin CPR. Locate the proper hand position on the chest of the child.

**Step 5** Administer 30 chest compressions and look inside the child's mouth. If you see the object, remove it.

## You are the Provider: SUMMARY

**1. What should you immediately do on receiving this update from dispatch?**

Once you are informed that CPR is in progress, you should immediately request additional assistance. Effective treatment of a patient in cardiac arrest requires adequate personnel at the scene and during transport.

The type of backup you receive (ie, EMT versus paramedic) will depend on your EMS system and the resources that are available to you. An advanced life support (ALS) ambulance staffed with paramedics would be optimum; paramedics are able to establish vascular access, administer various cardiac medications, and perform cardiac monitoring and advanced airway management. Combined with early, high-quality CPR and defibrillation, early advanced care increases the patient's chance for survival.

Some EMS systems provide basic life support (BLS) only; they are not staffed with AEMTs or paramedics. In very small EMS systems, only one EMT ambulance may cover a large area. If you do not have access to other EMTs or to paramedics, you should request assistance from the fire department. Fire departments are often staffed with at least one or two EMRs who are able to perform CPR and assist with certain BLS interventions.

Regardless of the resources available to you, you should request them as soon as possible—in this case, as soon as you are advised that CPR is in progress. One EMT cannot *effectively* treat a cardiac arrest patient during transport; he or she would have to perform continuous CPR, which would arguably result in rescuer fatigue and decreased chest compression effectiveness.

In some EMS systems, two ambulances are automatically dispatched to calls that may involve a patient in cardiac arrest (ie, an "unconscious" person). In other systems, EMRs are dispatched to assist the ambulance. As an EMT, you must be familiar with the resources that are available to you and know when it is appropriate to request them.

**2. What should be your initial actions on arriving at this scene?**

After ensuring your own safety, you should approach this patient as you would any other patient, by performing a primary assessment. Although the dispatcher has advised you that bystander CPR is in progress, you must still assess the patient to confirm that he is indeed apneic and pulseless and requires CPR.

Your primary assessment should take only a few seconds, just long enough to confirm that the patient is in cardiac arrest. If so, begin CPR immediately, apply the AED as soon as it is available, and analyze the patient's cardiac rhythm. To avoid interrupting CPR, you should apply the AED pads around your partner's hands as he or she is performing chest compressions.

If the AED advises you to shock, deliver the shock and immediately resume CPR, starting with chest compressions. If the AED does not advise you to shock, immediately resume CPR, starting with chest compressions. During CPR, ask the bystanders if they witnessed the event and determine if they know anything about the patient (ie, past medical history, events leading up to the arrest).

Regardless of how a call is dispatched and whether or not you are assuming patient care from bystanders or other health care providers, it is important for you to always perform a primary assessment of the patient.

**3. What links in the chain of survival have been maintained at this point?**

Few people who experience prehospital cardiac arrest survive unless a rapid sequence of events takes place within a very narrow time frame. This sequence of events—called the chain of survival—emphasizes the most critical elements for treating cardiac arrest patients. There are five links in the chain of survival: early access, early CPR, early defibrillation, early advanced care, and post-arrest care.

*Early access* requires public education and awareness in the recognition of the early warning signs of a cardiac emergency and immediate activation of EMS. This link has been maintained because the bystander quickly recognized that the patient was experiencing a cardiac emergency and immediately called 9-1-1.

*Early CPR* is an essential component of the chain of survival. High-quality CPR will help keep blood, and therefore oxygen, flowing to the vital organs (ie, heart, brain), thus helping to keep these organs viable until additional care can be provided. Although CPR alone rarely resuscitates a cardiac arrest patient, in its absence, the chance of survival is low. This link in the chain of survival has also been maintained because the bystander began immediate CPR after calling 9-1-1.

The third link in the chain of survival, early defibrillation, has also been maintained because an AED is present and the patient can be quickly defibrillated if needed. Of all the links in the chain of survival, early defibrillation has the most profound impact on patient survival because approximately 70% of patients who experience sudden cardiac arrest are in a shockable rhythm (eg, ventricular fibrillation [V-fib] or pulseless ventricular tachycardia [V-tach]) initially. With early access and early CPR, defibrillation may successfully terminate these lethal cardiac arrhythmias in a significant number of patients. It is important to note that ventricular fibrillation and pulseless ventricular tachycardia are transient arrhythmias; they quickly deteriorate to asystole, a nonshockable rhythm. For each minute that defibrillation is delayed, the patient's chance for survival decreases by 7% to 10%.

The fourth link in the chain of survival, early advanced care, can only be maintained if you have ALS personnel at the scene or are very close to a hospital. Advanced level care includes interventions such as intravenous therapy, cardiac drug administration, cardiac monitoring, manual defibrillation, and advanced airway management. In this case, you do not have ALS personnel available at the scene; therefore, it is critical that you transport the patient as soon as possible.

If *any one* of the links in the chain of survival is absent, the patient's chance for survival decreases. If CPR is not performed within the first few minutes of the arrest, for example, the patient's chance of survival decreases. Likewise, if the administration of defibrillation is delayed for more than 10 minutes, the

# You are the Provider: SUMMARY

patient's chance of survival decreases. The patient's chance for survival is greatest when *all the links* in the chain are strong.

**4. Why is it so critical to minimize interruptions in CPR?**

Even when CPR is performed optimally (eg, proper rate and depth), chest compressions only deliver about one third of a person's normal cardiac output. It is critical to perform CPR correctly; the depth of compressions should consistently be at least 2" in the adult and the rate of chest compressions should be at least 100 per minute.

If CPR is performed properly and with minimal interruption, it is often enough to keep the patient's vital organs viable until defibrillation and more advanced care can be provided. Of course, this assumes that defibrillation and advanced care are provided within a short period of time.

Within a few seconds of stopping chest compressions, the pressure generated in the arteries drops to near zero. With this fact in mind, frequent or prolonged interruptions in chest compressions will not even provide the minimum perfusion needed to keep the vital organs viable. This has clearly been linked to low survival rates from cardiac arrest.

As soon as cardiac arrest has been confirmed, it is crucial to begin CPR immediately and apply the AED as soon as it is available. Even when the AED pads are being applied, chest compressions should continue; the rescuer should apply the pads around his or her partner's hands.

**5. Should you remove the medication patch or leave it in place? Why or why not?**

It is not uncommon to encounter a patient who is wearing a medication patch. With the transdermal patch, medication is absorbed through the skin. A number of medications are delivered via the transdermal route, including fentanyl (a narcotic analgesic) for chronic pain, and nitroglycerin (a vasodilator) for angina, among others.

The patch in this patient is located on his right upper chest, which is where you will place one of the AED pads. Because of its location, the patch could interfere with the electrical current to the heart and may cause skin burns. To prevent this complication, you should remove the patch, wipe any residue from the skin, and then apply the AED pads. Do not forget to observe standard precautions!

**6. What does the bulge and scar over the patient's left chest indicate? How will this affect the way you treat the patient?**

Patients who are at high risk for certain cardiac arrhythmias and cardiac arrest may have an automatic implantable cardioverter/defibrillator (AICD) or pacemaker. The AICD will deliver shocks directly to the heart when it detects a lethal cardiac arrhythmia. Implanted pacemakers are used to increase the patient's heart rate if it falls below a given value.

It is easy to recognize these devices because they create a hard lump or bulge on the patient's chest and usually have a scar over them. Most AICDs and pacemakers are placed beneath the skin in the upper left aspect of the chest, just below the clavicle. If the AED pads are placed directly over the device, shocks delivered by the AED may be less effective. Therefore, if you identify an AICD or pacemaker, you should place the AED pad at least 1" away from the device. Because most of these devices are implanted in the upper left chest, this should not be an issue. The pads are placed to the right of the upper sternum and to the lower left chest, just below the nipple, so they should be well beyond 1" from the device.

Occasionally, the AICD will deliver shocks to the patient; when it does, you will see the patient's muscles twitch. However, because the electricity delivered by the device is so low, it should not pose a threat to your safety. Follow your local protocols regarding patients with AICDs or implanted pacemakers.

**7. How should you continue to treat this patient?**

You have restored a pulse in your patient; however, his breathing is not adequate. Agonal breaths are slow, occasional breaths are ineffective and do not produce adequate minute volume.

Some patients may have an intact gag reflex, despite being unconscious and unresponsive; in these cases, an oropharyngeal airway is contraindicated. You should insert a nasopharyngeal airway and continue to provide rescue breathing. Deliver one breath every 5 to 6 seconds (10 to 12 breaths/min); each breath should be delivered over 1 second (just enough to produce visible chest rise). Closely and carefully monitor the patient's pulse and be prepared to resume CPR if necessary.

You should assume that the patient has a full stomach and have suction ready in case he regurgitates. Remember that mortality increases significantly if aspiration occurs.

It is important to avoid hyperventilating the patient. Hyperventilation, which is defined as ventilating too fast *or* with too much force, can cause several negative effects. It increases the incidence of gastric distention, which increases the risks of regurgitation and aspiration. It also hyperinflates the lungs, which reduces the amount of blood that returns to the heart (preload), and subsequently reduces the amount of blood that is ejected from the left ventricle (stroke volume).

**8. Because the patient is no longer in cardiac arrest, should you remove the AED pads? Why or why not?**

Although the patient is not in cardiac arrest, he is still at high risk for redeveloping cardiac arrest. Therefore, you should not remove the AED pads; simply turn the AED off, continue rescue breathing, and prepare the patient for immediate transport.

If cardiac arrest recurs en route to the hospital, you should first ask your partner to stop the ambulance while you begin CPR. Remember, the AED will not analyze the cardiac rhythm if it detects movement.

As soon as your partner is in the back of the ambulance to assist you, turn the AED back on, reanalyze the patient's cardiac rhythm, deliver a shock if indicated, and resume CPR. Follow your local protocols or contact medical control regarding how many shocks you should deliver prior to initiating transport from the scene or resuming transport if the patient redevelops cardiac arrest en route to the hospital.

## You are the Provider: SUMMARY, continued

**9. Would an impedance threshold device (ITD) benefit your patient at this point?**

An impedance threshold device (ITD) is a valve device that is placed between the endotracheal (ET) tube and bag-mask device. It limits the amount of air that enters the thoracic cavity during the recoil phase between chest compressions. This results in negative intrathoracic pressure, which facilitates blood return to the heart (preload) and ultimately increases the amount of blood that is ejected from the heart during each chest compression. Despite the fact that the ITD attaches to the ET tube, it is a circulatory-assist device, not a ventilation device.

The ITD is only used for patients who are *apneic and pulseless*. At this point, your patient has a pulse and is breathing—albeit slowly and shallowly; therefore, the ITD is not indicated. However, if he redevelops cardiac arrest, the emergency physician may elect to use the ITD after he or she intubates the patient.

Although use of the ITD can help improve the effectiveness of CPR, it is important to note that the device is *not* a replacement for high-quality CPR, which includes pushing hard and fast, allowing the chest to fully recoil in between compressions, and limiting interruptions in CPR. If return of spontaneous circulation occurs, the ITD must be removed.

**10. What further treatment is indicated for this patient?**

Further treatment for your patient should consist of *careful* monitoring, keeping in mind that he remains at high risk for recurrence of cardiac arrest. In patients who are conscious and alert, the presence of a pulse is obvious; however, when a patient is unconscious and unresponsive, you must reassess for a pulse frequently.

Unconscious, unresponsive patients are at increased risk for regurgitation, which could lead to aspiration and increased mortality. Vigilantly monitor the patient's airway status and be prepared to turn his head to the side if he regurgitates. Maintain his airway with manual positioning and a basic airway adjunct, in this case, a nasal airway.

Although the patient is breathing, his breaths are slow and shallow. Slow, shallow (reduced tidal volume) respirations will not produce adequate minute volume and need to be assisted; therefore, continue to assist the patient's ventilations with a bag-mask device, but *do not hyperventilate him*. Deliver each breath over 1 second while observing for visible chest rise. Monitoring his oxygen saturation ($Sao_2$) level and heart rate will help you determine if your assisted ventilations are adequate.

## You are the Provider: SUMMARY, continued

As mentioned earlier, do not remove the AED pads. Turn the AED off but be prepared to stop the ambulance if he redevelops cardiac arrest.

Depending on your local protocols, you may consider elevating the patient's legs 6″ to 12″ in an attempt to improve his blood pressure (currently 86/66 mm Hg) and to improve cerebral perfusion.

### EMS Patient Care Report (PCR)

| | | | |
|---|---|---|---|
| **Date:** 12-29-09 | **Incident No.:** 011109 | **Nature of Call:** Cardiac arrest | **Location:** 123 Wilshire Ave. |

| | | | | | |
|---|---|---|---|---|---|
| **Dispatched:** 1445 | **En Route:** 1447 | **At Scene:** 1454 | **Transport:** 1508 | **At Hospital:** 1518 | **In Service:** 1528 |

**Patient Information**

| | |
|---|---|
| **Age:** 48<br>**Sex:** M<br>**Weight (in kg [lb]):** 77 kg (170 lb) | **Allergies:** Unknown<br>**Medications:** Unknown<br>**Past Medical History:** Unknown<br>**Chief Complaint:** Cardiac arrest |

**Vital Signs**

| | | | | |
|---|---|---|---|---|
| **Time:** 1454 | **BP:** N/A | **Pulse:** 0 | **Respirations:** 0 | **$SaO_2$:** N/A |
| **Time:** 1458 | **BP:** N/A | **Pulse:** 0 | **Respirations:** 0 | **$SaO_2$:** N/A |
| **Time:** 1501 | **BP:** 70/40 | **Pulse:** 100 | **Respirations:** 4 | **$SaO_2$:** 82% |
| **Time:** 1508 | **BP:** 86/66 | **Pulse:** 94 | **Respirations:** 8 | **$SaO_2$:** 95% |

**EMS Treatment (circle all that apply)**

| | | | | |
|---|---|---|---|---|
| **Oxygen @** 15 **L/min via (circle one):** **NC NRM Bag-Mask Device** | | **Assisted Ventilation** | **Airway Adjunct** | **CPR** |
| **Defibrillation** | **Bleeding Control** | **Bandaging** | **Splinting** | **Other:** |

**Narrative**

Medic 51 dispatched to grocery store parking lot for "CPR in progress." On arrival at the scene, found two bystanders performing CPR on the patient, a 48-year-old male. Medic 48 was dispatched to the scene to assist. Primary assessment revealed that the patient was apneic and pulseless. Continued one-rescuer CPR for 2 minutes while the AED was being prepared. Per one of the bystanders, the patient was about to get in his car when he suddenly grabbed his chest, slumped against the car, and eased himself to the ground. There was no trauma involved. The bystander further stated that by the time he got to the patient, he was unconscious and without pulse or breathing. After 2 minutes of CPR, analyzed patient's cardiac rhythm with the AED and received a shock advised message. Delivered single shock and immediately resumed CPR. Medic 48 arrived at scene and assisted with CPR and airway management. The patient's past medical history was unknown; although he had an AICD and was wearing a medication patch, which was removed. Continued CPR for 2 minutes, reanalyzed the patient's cardiac rhythm, and received a no shock advised message. Continued CPR and attempted to insert an oral airway; however, the patient began to gag. Immediate reassessment revealed that he had a strong carotid pulse, but was not breathing adequately. Inserted a nasal airway, continued ventilations at 12 breaths/min, packaged the patient, and loaded him into the ambulance. EMT from Medic 48 assisted with patient care en route to the hospital. En route, reassessed patient and found that he remained unconscious and unresponsive; his respiratory rate increased, but the depth of his breathing remained shallow. Continued assisted ventilation and called in radio report to the receiving facility. Monitored the patient's pulse, elevated his lower extremities in an attempt to improve his blood pressure, and delivered him to the emergency department without incident. Gave verbal report to attending physician. Medic 51 cleared the hospital and returned to service at 1528. *End of report*

## Ready for Review

- Basic life support (BLS) is noninvasive emergency lifesaving care that is used to treat medical conditions, including airway obstruction, respiratory arrest, and cardiac arrest.
- BLS care focuses on what is often termed the ABCs: airway (obstruction), breathing (respiratory arrest), and circulation (cardiac arrest or severe bleeding).
- Cardiopulmonary resuscitation (CPR) is used to establish artificial ventilation and circulation in a patient who is not breathing and has no pulse.
- The goal of CPR is to restore spontaneous breathing and circulation; however, advanced procedures such as medications and defibrillation are often necessary for this to occur.
- Advanced life support (ALS) involves advanced lifesaving procedures, such as cardiac monitoring, administration of intravenous fluids and medications, and use of advanced airway adjuncts.
- The five links in the chain of survival are early access, early CPR, early defibrillation, early advanced care, and post-arrest care.
- The automated external defibrillator (AED) should be applied to any nontrauma cardiac arrest patient as soon as it is available.
- When using an AED on a child between 1 and 8 years of age, you should use pediatric-sized pads and a dose-attenuating system (energy reducer). If these are not available, an adult AED should be used. In infants (1 month to 1 year), it is preferable to perform manual defibrillation or use a dose-attenuating system. If these are not available, an adult AED should be used.
- As an EMT, it is your responsibility to start CPR in virtually all patients who are in cardiac arrest. There are only two general exceptions to the rule: You should not start CPR if the patient has obvious signs of death and you should not start CPR if the patient and his or her physician have previously agreed on do not resuscitate (DNR) or no-CPR orders.
- You are not responsible for making the decision to stop CPR. Once you begin CPR in the field, you must continue until one of the following events occurs:
  - S, the patient Starts breathing and has a pulse.
  - T, the patient is Transferred to another person who is trained in BLS, to ALS-trained personnel, or to another emergency medical responder.
  - O, you are Out of strength or too tired to continue.
  - P, a Physician who is present or providing online medical direction assumes responsibility for the patient and gives direction to discontinue CPR.
- An airway obstruction may be caused by various things, including relaxation of the throat muscles in an unconscious patient, vomited or regurgitated stomach contents, blood, damaged tissue after an injury, dentures, or foreign bodies such as food or small objects.
- The manual maneuver recommended for removing severe airway obstructions in the conscious adult and child is the abdominal-thrust maneuver (the Heimlich maneuver).

## Vital Vocabulary

**abdominal-thrust maneuver** The preferred method to dislodge a severe airway obstruction in adults and children; also called the Heimlich maneuver.

**advanced life support (ALS)** Advanced lifesaving procedures, some of which are now being provided by the EMT.

**basic life support (BLS)** Noninvasive emergency lifesaving care that is used to treat medical conditions, including airway obstruction, respiratory arrest, and cardiac arrest.

**cardiopulmonary resuscitation (CPR)** The combination of rescue breathing and chest compressions used to establish adequate ventilation and circulation in a patient who is not breathing and has no pulse.

**gastric distention** A condition in which air fills the stomach, often as a result of high volume and pressure during artificial ventilation.

**head tilt–chin lift maneuver** A combination of two movements to open the airway by tilting the forehead back and lifting the chin; not used for trauma patients.

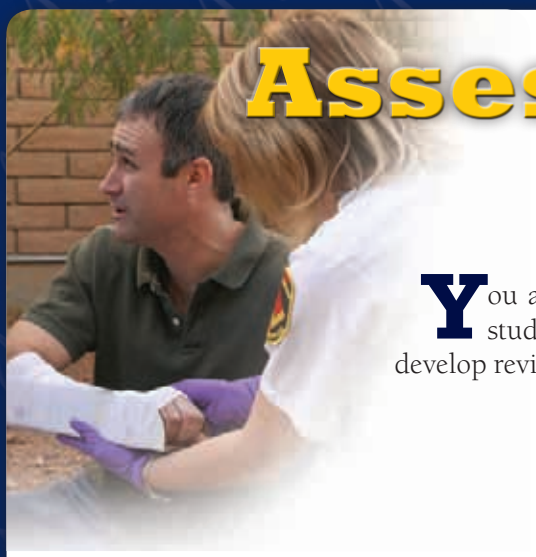
**impedance threshold device (ITD)** A valve device placed between the endotracheal tube and a bag-mask device that limits the amount of air entering the lungs during the recoil phase between chest compressions.

**jaw-thrust maneuver** Technique to open the airway by placing the fingers behind the angle of the jaw and bringing the jaw forward; used for patients who may have a cervical spine injury.

**load-distributing band (LDB)** A circumferential chest compression device composed of a constricting band and backboard that is either electrically or pneumatically driven to compress the heart by putting inward pressure on the thorax.

**mechanical piston device** A device that depresses the sternum via a compressed gas-powered plunger mounted on a backboard.

**recovery position** A side-lying position used to maintain a clear airway in unconscious patients without injuries who are breathing adequately.



# Assessment in Action

You and your partner will be teaching basic life support to a new class of EMT students in the morning. You use your downtime to prepare your lesson plan and develop review questions.

1. The links in the chain of survival include:
   - **A.** early access.
   - **B.** early defibrillation.
   - **C.** early advanced care.
   - **D.** all of the above.

2. Which of the following rhythms will the automated external defibrillator shock?
   - **A.** Normal sinus rhythm
   - **B.** Atrial fibrillation
   - **C.** Asystole
   - **D.** Ventricular fibrillation

3. What is the minimum amount of time that should be spent checking for spontaneous breathing in an unconscious child?
   - **A.** 5 seconds
   - **B.** 10 seconds
   - **C.** 15 seconds
   - **D.** 20 seconds

4. Each artificial breath should be delivered over a period of how many seconds?
   - **A.** 4
   - **B.** 3
   - **C.** 2
   - **D.** 1

5. What is the proper compression-to-ventilation ratio for adult one-rescuer cardiopulmonary resuscitation (CPR)?
   - **A.** 15:2
   - **B.** 30:2
   - **C.** 50:2
   - **D.** 100:2

6. When checking for a pulse in an infant, you should palpate which of the following arteries?
   - **A.** Carotid
   - **B.** Femoral
   - **C.** Brachial
   - **D.** Dorsalis pedis

7. When you are performing CPR on an adult or child, you should reassess the patient for return of respirations and/or circulation approximately every _____ minutes.
   - **A.** 5
   - **B.** 3
   - **C.** 2
   - **D.** 1

8. What is the preferred method of removing a foreign body in a conscious adult?
   - **A.** Back slaps
   - **B.** Abdominal thrusts
   - **C.** Chest compressions
   - **D.** Manual removal

9. After you have started CPR in the field, under what circumstances can you stop?

10. Explain why the presence of gastric distention is dangerous.