The Healthcare Medicine Institute presents

CPR #1

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Contents

CPR #1

Purpose

This course packet was designed to help you remain knowledgeable regarding the steps and processes for helping someone experiencing sudden cardiac arrest (SCA). The following is a summary from the National Institutes of Health (NIH) on the topic of CPR:

> When someone's blood flow or breathing stops, seconds count. Permanent brain damage or death can happen quickly. If you know how to perform cardiopulmonary resuscitation (CPR), you could save a life. CPR is an emergency procedure for a person whose heart has stopped or is no longer breathing. CPR can maintain circulation and breathing until emergency medical help arrives.
>
> Even if you haven't had training, you can do "hands-only" CPR for a teen or adult whose heart has stopped beating ("hands-only" CPR isn't recommended for children). "Hands-only" CPR uses chest compressions to keep blood circulating until emergency help arrives. If you've had training, you can use chest compressions, clear the airway, and do rescue breathing. Rescue breathing helps get oxygen to the lungs for a person who has stopped breathing. To keep your skills up, you should repeat the training every two years.

Sudden Cardiac Arrest

Before we can begin consider how to care for a person in cardiac arrest, let's first review the definition of sudden cardiac arrest.

Like every muscle in your body, the heart muscle moves when stimulated by an electrical impulse. The heart, however, does not rely on your brain to

send these impulses like all other muscles; it creates its own electrical current from nodes located inside the heart. The sinoatrial node, located in the upper right portion of the heart, is primarily responsible for creating this impulse that then travels through conduction pathways through the muscle in an organized manner. As this impulse travels it stimulates the different areas of the heart to contract, pumping blood through the body. When these impulses become disorganized or do not not pass through the muscle in the correct manner, called an arrhythmia, the heart muscle can have trouble pumping effectively.

The most common cause of SCA is an arrhythmia called ventricular fibrillation (VF). In VF, the impulses become erratic and causing the heart muscle to quiver instead of pump, stopping the flow of oxygen and nutrients through the body. This arrhythmia can be caused by an electric shock, drugs, or trauma.

According to the NIH, the following is the definition of ventricular fibrillation:

> **Ventricular Fibrillation**
> V-fib occurs if disorganized electrical signals make the ventricles quiver instead of pump normally. Without the ventricles pumping blood to the body, sudden cardiac arrest and death can occur within a few minutes.
> To prevent death, the condition must be treated right away with an electric shock to the heart called defibrillation.
>
> V-fib may occur during or after a heart attack or in someone whose heart is already weak because of another condition. [1]

A myocardial infarction (i.e., a heart attack) occurs when the arteries that feed the heart with oxygen become blocked, which can also cause SCA.

According to the NIH, the following is the definition of a heart attack:

> **What Is a Heart Attack?**
> A heart attack happens when the flow of oxygen-rich blood to a section of heart muscle suddenly becomes blocked and the heart can't get oxygen. If blood flow isn't restored quickly, the section of heart muscle begins to die.

1 nhlbi.nih.gov/health/health-topics/topics/arr/types

Heart attack treatment works best when it's given right after symptoms occur. If you think you or someone else is having a heart attack, even if you're not sure, call 9–1–1 right away. [2]

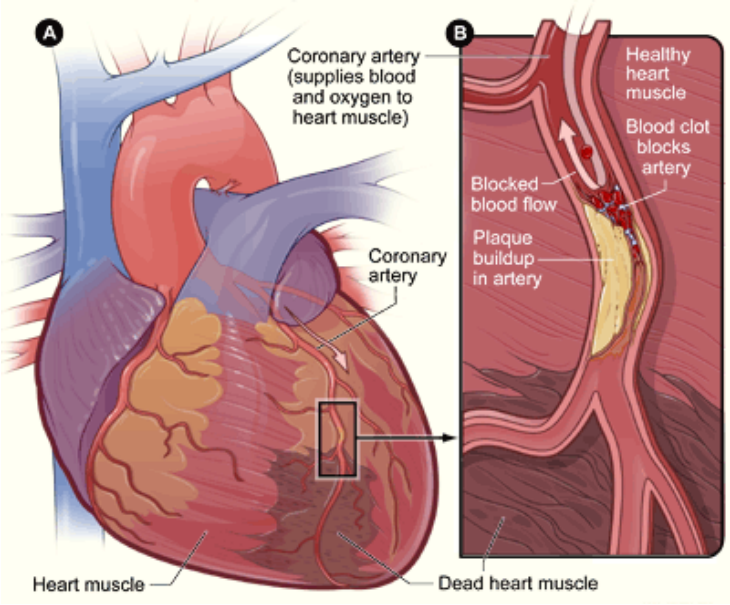


Figure A is an overview of a heart and coronary artery showing damage (dead heart muscle) caused by a heart attack. Figure B is a cross-section of the coronary artery with plaque buildup and a blood clot. (credit: NIH – National Heat, Lung, and Blood Institute)

It is important to note that vital organs begin suffering immediate damage during SCA. The goal for treating SCA is to correct the arrhythmia to regain blood flow throughout the body before these organs suffer irreversible damage. Studies have shown that immediate bystander cardiopulmonary resuscitation (CPR) and the use of an automated external defibrillator (AED) offer the best chance of survival for the patient.

2 nhlbi.nih.gov/health/health-topics/topics/heartattack/

Know when to help

Recognizing a person is suffering from sudden cardiac arrest is an important step in beginning appropriate treatment. If sudden cardiac arrest is suspected, it is important to complete a quick assessment to determine if the patient requires CPR or other advanced care.

Assessing the patient

A patient suffering from SCA will appear unconscious and unresponsive. This does not mean that someone who is awake is not suffering from another medical emergency. If you suspect that a person is experiencing a medical emergency for any reason, call for help. In the USA, calling 911 activates the emergency response system. Stay with them until medical help arrives if possible.

Check for Safety

The most important first step in any emergency is to make sure the area is safe. Do not put yourself in a dangerous situation, which could result in you also being a patient. Check the area for dangers such as electrical shock, violence, or traffic. If possible, move the patient to a safe location before providing any care. If you are unable to move the patient to safety, immediately leave and call for help.

Check for Responsiveness

Once you are sure you are in a safe environment, attempt to wake the patient. **Shake or tap the patient and shout, “Are you ok?”**

- If the patient responds, try to determine if additional help is needed. If you have any doubt as to whether or not the patient requires further assistance, call 911 for help.

- If the patient does not respond, get help. If bystanders are available, send one to call 911 for help and to look for an automated external defibrillator (AED). If no bystanders are available, immediately leave the

patient and call 911 (or use a cell phone) and attempt to find an AED. Return to the patient as soon as possible.

Image 2: Check the patient for signs of life such as chest rise or other movement. *Credit: Virginia State Parks CC / BY*

Check for Signs of Life

After you or a bystander has activated the emergency response system by calling 911, return to the patent. Take at least 5 seconds, but no more than 10, to closely watch the patient for any signs of life (image 2). Look for chest rise (indicating breathing), listen for grunting, groaning, or sounds of heavy breathing, or place your hand on the patient's chest to feel for rise and fall. If any of these signs of life are present, the patient is not experiencing SCA but may be experiencing a life-threatening medical emergency. Stay with the patient until help arrives and continue to check for these signs of life. Note, gasping is not a sign of normal breathing.

Some advanced-level providers are trained to check the patient for a pulse and more thoroughly check the patient's airway and breathing. These steps are not wrong but can be difficult to perform and are time consuming if not practiced regularly. It is also possible for untrained rescuers to misinterpret these signs, causing them to inappropriately withhold CPR. It is therefore not recommended that lay-rescuers perform these steps.

If no signs of life are present, the patient is most likely in cardiac arrest and immediate action is required.

Calling for Help

It is important to call for help as soon as you suspect that the patient is requires help. While a patient in cardiac arrest needs CPR, most cases of SCA cannot be solved by CPR alone. CPR is also a physically-demanding activity and rescuers will quickly tire when correctly performing chest compressions. Once you activate the emergency response system, help is on the way. It is also possible to begin further care while calling for help, if mobile phones are available.

Self-Knowledge Check

What is the most important first step in helping in any emergency?

(Answer located at the bottom right corner of this exercise box.)

A) Check for Safety
B) Immediately call 911
C) Check a pulse
D) Check for signs of life

Answer: A

Know how to help

Compressions

Once you have identified that an adult is in SCA and requires CPR (and the emergency response system has been activated), the next step is chest compressions. In review, identification of SCA involved two major steps:

1. *Check for Responsiveness*
   Attempt to wake the patient: Shake or tap the patient and shout, “Are you ok?”

2. *Check for Signs of Life*
   Look for chest rise (indicating breathing), listen for grunting, groaning, or sounds of heavy breathing, or place your hand on the patient’s chest to feel for rise and fall. Advanced provider: check for pulse, airway, and breathing issues.

Chest compressions squeeze the heart, building up pressure within the heart’s chambers to begin pumping blood. Good compressions circulate oxygenated blood throughout the body, slowing the damage to the heart and other organs caused when these organs have stopped receiving blood from the heart. **It is important to provide good, quality chest compressions during CPR** to maximize blood flow and increase the chances of survival. Let’s look how to perform chest compressions for adults. According the the NIH, adults are defined as 9 years and older for purposes of CPR distinctions.[3] Later, we will go over how to provide help for children and infants.

Next is a photo example of chest compressions. Later, we will show many alternate and close-up views of this same procedure to better illuminate the techniques involved.

3 medlineplus.gov/ency/article/000013.htm

Image 3: Position your body directly over the patient, locking your elbows to provide chest compressions. *Credit: Betsy Weber CC / BY*

Expose the Chest

First, quickly expose the adult patient's chest. This allows rescuers to ensure proper hand placement and prepares the patient for use of the AED without having to stop compressions when one becomes available. If the patient is not on their back, carefully place the SCA victim on their back. In some cases, their may be the possibility of a spinal injury. If another person is available to help, the two of you can turn the patient onto the back without twisting the head or neck. This helps to prevent further complications relating to spinal injuries.

Compression Technique

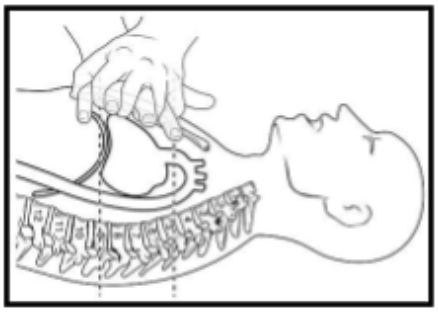


Image 4: Proper hand placement during CPR compresses the heart forcing blood flow. *Credit: OpenStax College CC / BY*

- To perform compressions, position yourself at the patient's side.
- Place the heel of one hand on the sternum in the center of the chest between the nipple line.
- Place your other hand on top of the other, interlocking your fingers. Slightly pull your fingers back so that only the heel of your hand is on the patient's chest.
- Lean over the patient so that your shoulders are directly over your hands and lock your elbows (image 3).
- Begin by pushing straight down onto the chest hard and fast. Press down approximately at least two inches (5 cm).
- Lift up, bringing your weight completely off the chest but keeping the hands in place. Let the chest completely rise.
- **Continue to do this at a rate of 100 per minute.**

It is important to ensure that your compressions are hard and fast. With each compression you are building pressure inside the chest to help push blood to vital organs (image 4). Compressions that are too shallow or too slow do not build the necessary pressure and will not improve the chance of survival. It is also important to release the pressure on the chest so that the heart can refill with blood before your next compression. In review:

- The hard and fast compression move the chest downward approximately 2 inches to push blood to vital organs.
- The release of pressure refills the heart with blood and is accomplished by letting the chest completely rise.

Some rescuers have been trained to provide ventilations to a patient after 30 compressions. If you have not received hands-on training to do this, do not stop compressions. Continue providing compressions, at least two inches deep, at a rate of at least 100 per minute or until help arrives or until you can no longer physically continue.

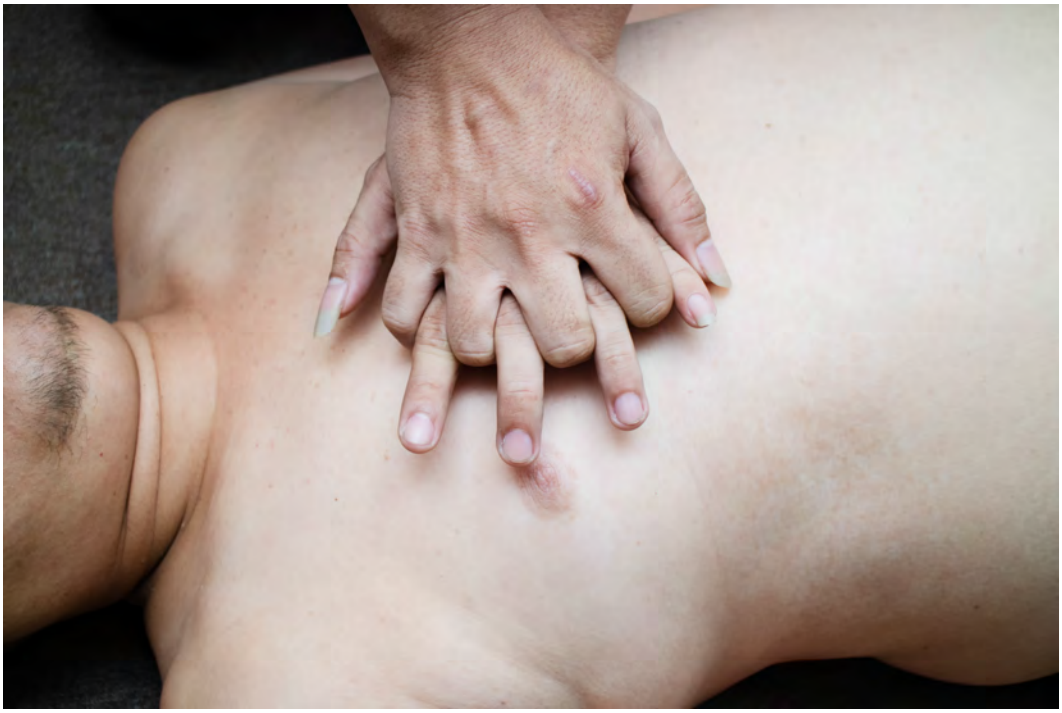
Compressions can be very physically demanding. If other help is available, try switching rescuers every two minutes until advanced care arrives. This ensures that compressions remain effective and improve the chance of

survival. Remember, if there is movement, breathing, coughing, do not apply chest compressions.

Chest Compressions

Chest Compressions

Chest Compressions



Chest Compressions

Chest Compressions

Ventilations

CPR is most effective when the rescuer can increase the level of oxygen available in the blood by providing ventilations. This can be accomplished by advanced methods such as endotracheal intubation, a bag-valve mask with supplemental oxygen, or even the use of a pocket mask or other barrier device during mouth-to-mouth. While these methods do provide some benefit during CPR, they can be difficult to perform properly. **If you are uncomfortable providing ventilation to a patient, skip this step and provide compression-only CPR.** Sometimes, compression-only CPR is termed hands-only CPR.

30 Compressions, 2 Breaths

When providing ventilations, first perform 30 quality chest compressions. Then, perform a head-tilt chin-lift by placing two fingers of one hand under the patient's chin and the other hand on the patient's forehead. Tilt the

head backward, extending the neck. This movement opens the patient's airway by moving the tongue from the back of the throat. In review, two fingers place under the chin lift up the head. Pushing on the forehead helps the two finger chin lifting technique to adequately tilt the head to open the airway.

Place your barrier device on the patient's face. Provide a breath, stopping when you notice chest rise. Chest rise is the best indication that the ventilation was deep enough to enter the lungs. If the chest does not rise, reposition the airway by completing another head-tilt chin-lift. Provide a second breath following the same steps.

During CPR, the goal is to stop compressions for as little time as possible. Rescuers should practice the skill of correctly providing two ventilations and returning to compressions in less than 10 seconds. **Continue this cycle of 30 compressions and two breaths until help arrives or the patient regains consciousness.**

Steps Review

- Check for safety of the scene. If needed, move the victim to safety.
- Check for responsiveness – Shake or tap, "Are you okay?"
- If someone else is present, have them call 911 and get AED. If no one else is present, shout for help.
- Check for signs of life to determine SCA: check for breathing. Advanced rescuers check for a pulse. No more than 10 seconds for this process is appropriate. Gasping is not normal breathing.
- Activate the emergency response system by calling 911 and retrieve an AED.

  For advanced rescuers: if there is a pulse but no normal breathing, provide rescue breathing ventilations at a rate of 1 breath every 5 – 6 seconds (10 – 12 breaths / minute). If not already done, call 911 after two minutes. Resume and check pulse every two minutes.
- If no breathing or only gasping and no pulse: Apply chest compressions and ventilations (30:2).
- Use an AED when it arrives on the scene.

Self-Knowledge Check
What is the appropriate compression to ventilation ratio for adult CPR? A) 15:2 B) 5:1 C) 30:2 D) 20:1 Answer: C

Youth

Children 1 – 8 Years

SCA in children is a rare event. While the ultimate goal of keeping blood flowing to the vital organs remains the same, the process changes slightly when helping children. The definition of a child for the purposes of CPR is any patient between 1 – 8 years of age. Under 1 is considered an infant. Some more advanced providers are taught to look for signs of puberty, such as chest or underarm hair for males, and breast development in females as the indicator for when a child has become an adult.

Two Minutes of Compressions

When assessing a child who appears to be in SCA, perform your assessment just as you would for an adult. If you find that the child is not showing signs of life, send someone to call 911 for help. **If there is no one else, it is recommended that you perform two minutes of CPR before leaving the child and calling 911 for help.** This is distinct from the recommendations for adults. For adults, call for help immediately if alone; for children in SCA, leave the child and call for help only after two minutes of CPR has been performed.

Press Down 1/3 – 1/2 Chest Depth

If you are alone, perform 30 compressions at a rate of no less than 100 per minute, just like the adult. **Because children are smaller than adults, use a depth of ⅓ to ½ the depth of the chest, do not exceed 2 inches.**

Ventilations

Open the airway with the head-tilt, chin-lift maneuver but only slightly extend the neck. The correct position looks as if the child is sniffing.

Provide two breaths by covering the child's mouth with yours while watching for chest rise, taking no more than 10 seconds to return to compressions. Pinch the child's nose closed while providing breaths.

Continue this 30:2 ratio until help arrives. If you are not alone and have someone able to help you, perform CPR as described but use a ratio of 15 compressions to 2 breaths. Remember to only provide enough breath to see visible chest rise. DO NOT overinflate the lungs. Repeat the process until the child is breathing on their own or until help arrives to provide emergency medicine.

Compression to Ventilation Ratio

- If alone, 30:2
- If assisted, 15:2

One Handed Compression

It is appropriate to use only one hand when doing compressions on a child. Place the other hand on the child's forehead to keep the head tilted back.

Steps

- Check for safety of the scene. If needed, move the victim to safety.
- Check for responsiveness – Shake or tap, "Are you okay?"
- If someone else is present, have them call 911 and get AED. If no one else is present, shout for help. (Do not leave the child until 2 minutes of CPR compressions have been performed. CPR starts after checking for signs of life in the next step.)
- Check for signs of life to determine SCA: check for breathing. Advanced rescuers check for a pulse. No more than 10 seconds for this process is appropriate. Gasping is not normal breathing.
- For advanced rescuers: if there is a pulse but no normal breathing, provide rescue breathing ventilations at a rate of 1 breath every 3 – 5 seconds (12 –20 breaths / minute) and call 911 after two minutes.

- If no breathing or only gasping and no pulse: Apply chest compressions and ventilations (30:2 unassisted, 15:2 assisted).
- If alone, after 2 minutes of CPR, activate the emergency response system by calling 911 and retrieve an AED. If alone and the the emergency response system is activated (by calling 911) and an AED is present, use the AED to analyze rhythm to see if there is a need for a shock.

Infants

Performing CPR on infants is very similar to the process with children. Continuing CPR for two minutes before leaving to call for help is identical as with children 1 – 8 years of age. Also, the depth of compressions (⅓ to ½ the depth of the chest) and the compression-to-ventilation ratios with two rescuers for children 1 – 8 are all appropriate for infants. The maximum depth for infants is approximately 1.5 inches. For infants, flick the bottom of the foot in an attempt to elicit a response to check for responsiveness.

The primary difference between children 1 – 8 and infants is the hand positioning used when performing compressions. When you are performing CPR by yourself, utilize the 2-finger technique by placing your index and middle finger on the center of the breastbone, between the nipples, pushing down on the chest. If you have another rescuer with you, use the two thumb encircling-hands technique by wrapping your hands around the baby's body, overlapping your thumbs on the center of the breastbone. Squeeze your hands together performing compressions.

2-finger technique

2-finger technique

Two thumb encircling-hands technique

Knowledge Check

What is the age-range for using child CPR?

A) Birth – 3 years
B) 3 – 5 years
C) 0 – 10 years
D) 1 – 8 years

Answer: D

Automated External Defibrillators

What are They?

Automated External Defibrillators, or AED, is a device that determines if a patient in SCA needs an electrical shock and then delivers that shock. Recent research has shown that the use of an AED nearly doubles the chance of survival in SCA. They are safe and easy to use and should be used whenever possible during SCA.

How to Use Them

Once you have determined in your assessment that a patient appears to be suffering from SCA (unconscious, unresponsive, and displays no signs of life), you should attempt to find an AED while calling for help. When returning to the patient, use the AED as soon as it is available

The first step in using an AED is to turn the device on. Some units have an obvious power button while others turn on automatically when you open the case. Once you power up the device, instructions from the unit will begin. These instructions can be through a verbal recording or flashing lights but all AEDs will direct you in the proper steps to serve as a reminder when using them in emergency situations.

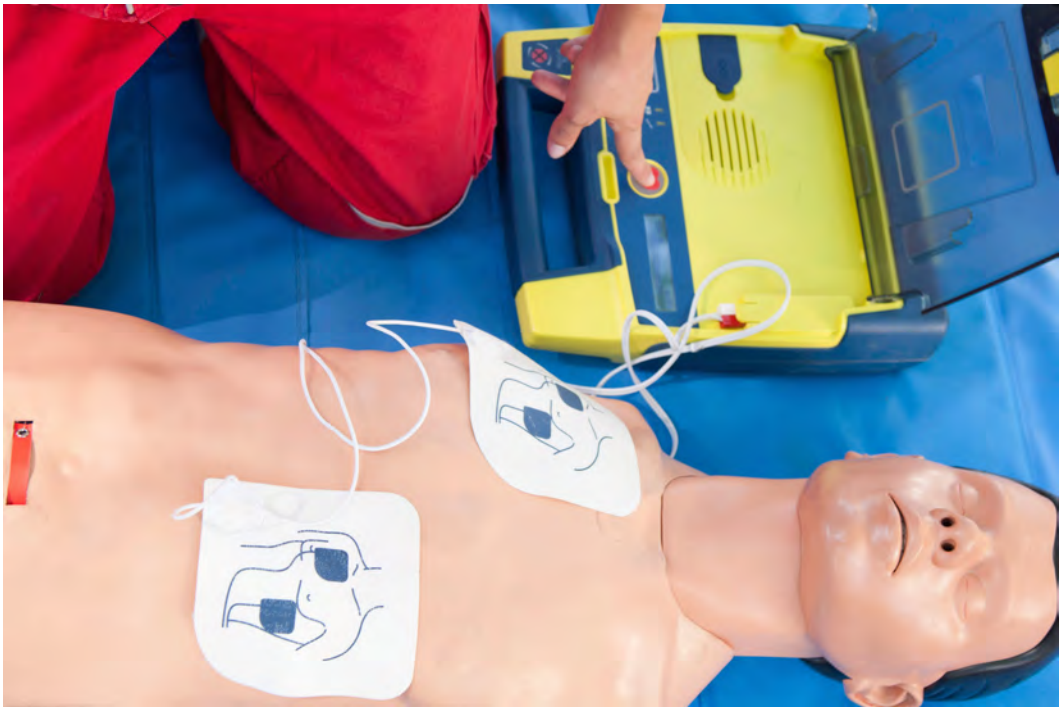
Once the device is on, you will be asked to apply the pads to the patient's chest. This requires you to expose the chest if you have not done so already during your assessment steps. Remove the backing from the pads and place one pad, sticky side down, on the right upper chest just below the shoulder. Place the other pad on the lower left chest just below the nipple (Image 5). Plug the pads into the device if they are not already plugged in. If there are multiple rescuers present, it is best to continue CPR while another rescuer applies the pads.

The AED will then direct you to clear the patient so it can analyze the heart rhythm. It is very important during this phase that you ensure that no one,

not even you, is touching the patient. During the pause, the computer inside the AED is reading the patient's electrical heart rhythm. If anyone is touching the patient during this it can cause the computer to misinterpret the rhythm and recommend an incorrect treatment.

Image 5: Place one pad on the upper right chest and the other on the lower left chest when using an AED. *Credit: Anita Hart CC / BY*

Once the AED has interpreted the patient's heart rhythm it will indicate whether a shock is advised or not. If a shock is advised, most AEDs will begin charging immediately (don't worry, it won't shock you during this). Other units require that you push a button to begin charging. Charging times differ for every unit with some newer units now pre-charging immediately once turned on. Recent research suggests that compressions be initiated during this charging time to reduce the amount of time compressions aren't being performed.



AED

The AED will sound an alarm when charging is complete and ready to shock. This provides you a reminder to ensure that everyone clears the patient. It is imperative that you look up and down the patient to be absolutely sure no one is touching the patient before pushing the shock button. Once you have ensured that everyone is clear, push the shock button on the AED. The AED will deliver an electric shock between the two pads to the patient. You will notice the patient's body arch upwards slightly or appear to jump. Once the patient's body has relaxed, the shock is over. Resume compressions immediately.

If the AED determines that a shock would not help the patient's current rhythm it will tell you that no shock is advised. Begin CPR for two minutes. This does not mean that your assessment of the patient and decision to start CPR was incorrect. It simply means that the patient's electrical rhythm would not be helped by an electrical shock and further treatment is necessary.

After delivering a shock or determining that no shock is needed, the AED will begin a two-minute countdown while you are performing CPR. At the end of two minutes it will remind you to check the patient. Check your

patient again for signs of life including evidence of breathing or movement. If no signs of life are present, allow the AED to analyze again and complete the process again. If signs of life are present, turn off the AED but leave the pads attached.

Special Considerations

Water

There is often a concern when using electricity around water. Modern AEDs are usually safe to use around water. It is not necessary to completely dry a patient wet from being exposed to water. Even wet pants are ok, though a wet shirt should be removed in order to apply the pads.

The largest concern when using an AED on a wet patient is the area where the pads will be applied. Using a towel, quickly wipe the chest to remove standing water on the chest where the pads will be placed. As long as the pads can firmly secure to the skin, the electrical current will flow through the patient between the two pads.

Medication patches

Sometimes you will notice medication patches on the patient's chest. The medicine under these patches is designed to absorb through the skin. If the location of the patches will make pad placement difficult, simply remove the patch and quickly wipe the area with a towel. If the patches do not interfere with pad placement, simply leave them in place.

When removing the patch, be careful not to touch the skin under the patch or the underside of the patch itself with your bare hands. The medicine, if it gets on your skin, can absorb through the hands and into your body causing unwanted effects.

Pacemakers

Some patients have had an internal pacemaker placed under their skin. These can often be seen by noticing a hard lump near one of the patient's shoulders about the size of a deck of cards. If the pacemaker is on the right side, do not place the AED pad on top of the device. Simply place the pad below or just to the side of the pacemaker.

Some pacemakers can also function as an internal defibrillator much the same way as an AED. You may even notice the patient jump slightly every few minutes as the internal defibrillator attempts to correct the patient's heart rhythm. This movement should not be considered a sign of life. In fact, it most often confirms your suspicion of SCA. When treating these patients, ignore these small jumps and follow the correct steps of CPR, using your AED when appropriate.

Body Hair

The presence of body hair itself does not present a problem when using the AED. In some patients, however, the amount of body hair prevents the pads from adhering to the patient's skin. When the pads do not make full contact with skin, the electrical shock is less effective and can cause burn injuries to the patient.

The most effective way to avoid this issue is to use a razor to quickly shave the area where the pads will go. Some AEDs come with a small response kit attached that includes a razor for this purpose. If there is no razor available but you have an extra set of pads available, place the first set of pads in the correct location, then quickly remove the pad. Discard these pads and use the second set with the AED.

Children

The use of AEDs in children and infants is acceptable. Many AEDs can be placed in a "pediatric" mode that decreases the amount of electricity delivered during a shock. This mode may be activated by a card you insert

into a designated slot. Some AEDs also recognize when a pediatric-sized pad has been plugged into the unit and automatically switches into pediatric mode. It is recommended that the pediatric mode be used for all patients under 8 years old.

If there is no pediatric mode available, or you cannot easily see how to use such a mode, you can continue to use the AED in the adult mode. While the amount of electricity delivered may be more than the patient needs, it is better than delivering no shock at all. When placing the adult pads on a pediatric patient, if the pads overlap when placed on the chest, place one pad on the right chest and the other on the patient's back directly behind the first pad.
It is important to understand that, while an adult unit or pads can be used on a pediatric, it is NOT acceptable to use a pediatric unit or pads on an adult. Only adult pads should be used for adults.

Knowledge Check

What is the first action you should take when arriving at the patient's side with an AED?

A) Turn the unit on
B) Place the pads on the chest
C) Call for help
D) Assess the patient

Answer: A

Knowledge Check

If you do are helping a child in cardiac arrest but do not have child AED pads with your AED, you should:

A) Wait for the ambulance
B) Use adult pads
C) Cut the pads down to size
D) Place one pad on the chest and the other on the abdomen

Answer: B

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