

Science Education Collection

Basic Life Support: Cardiopulmonary Resuscitation and Defibrillation

URL: <https://www.jove.com/science-education/10199>

Overview

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High-quality cardiopulmonary resuscitation (CPR) is the single most important determinant of intact survival in cardiac arrest, and it is critical that all healthcare workers are able to perform this lifesaving technique effectively. Despite the conceptual simplicity of CPR, the reality is that many providers perform it incorrectly, resulting in suboptimal survival outcomes for their patients. This video looks at the essential elements of high-quality CPR, discusses the physiologic basis for each step, and describes how to optimize them in order to enhance survival outcomes. Appropriate prioritization of interventions in cardiac arrest and methods for optimizing resuscitation performance are covered as well.

Procedure

1. Assess the patient

1. Assess responsiveness by speaking loudly and stimulating the patient. If the patient is unresponsive, the diagnosis is cardiac arrest until proven otherwise.
2. Assess circulation by palpating the carotid artery. Do this for no more than 10 seconds; longer assessment time delays initiation of resuscitation.
3. Assess airway and breathing by observing for respiratory effort while you are palpating the pulse. This is called "CAB assessment" because the emphasis is on circulation; airway/breathing are secondary considerations.
4. Call for help as soon as you confirm that the patient is indeed unresponsive.

2. Ask for emergency equipment. The most important item to get right away is a defibrillator.

3. Position the patient and rescuer for chest compressions.

1. Roll the patient onto the back.
2. Make the bed flat and get railings out of the way. Many hospital beds have a CPR level to allow this to be done quickly.
3. Place a backboard under the patient. Chest compressions performed on a soft surface like a bed are not effective, so this is critical for the success of the resuscitation. Mechanical energy will flow down the path of least resistance, and your compression will deform the most compressible object under it. For a patient in a bed, this will be the mattress. Placing a backboard under the patient prevents compression of the mattress, ensuring that your compression deforms the chest wall instead. This allows compression of the heart, providing cardiac output.
4. Position yourself at an appropriate height above the patient so that the compressions are more ergonomic and effective. This is most easily accomplished by standing on a step stool. Incorrect positioning may lead to less effective compressions and greater rescuer fatigue.

4. Perform chest compressions.

Complete the steps below quickly. The first compression must be delivered within 30 seconds of the time of arrest.

1. Place the heel of one hand directly over the sternum at the nipple line. Make sure this hand is in the midline of the patient's body and not off to one side.
2. Place the other hand over the first hand, interlacing the fingers.
3. Lock the elbows.
4. Position the body so that the elbows are directly over the wrists, and the shoulders are directly over the elbows. If you are not able to position yourself correctly, you are too low relative to the patient and need to lower the bed or use a step stool as discussed previously.
5. Moving your entire body downward like a piston, depress the patient's sternum at least 2-2.5 inches (5-6 cm). Adequate compression depth is essential in order to provide sufficient stroke volume to perfuse the heart and brain.
6. Release pressure on the sternum completely between compressions. Under normal circumstances, negative interthoracic pressure causes blood to fill the heart. Leaning on the sternum raises interthoracic pressure and decreases cardiac filling, thereby decreasing stroke volume.
7. Depress the sternum again as above, and repeat these last two steps 100-120 times per minute. Correct rate is essential - compressing too slowly directly reduces cardiac output, while compressing too quickly impairs filling and decreases stroke volume.
8. Continue compressions without interruption until resuscitation equipment arrives. CPR continuity is a major determinant of survival. Do not pause CPR to perform nonessential tasks like removing clothing or auscultating the heart. Even essential tasks like airway management and intravenous access should not be permitted to disrupt CPR.
9. Switch rescuers when needed. Chest compressions are exhausting, and if the quality of your CPR is suboptimal due to fatigue, have another rescuer step in. Be sure to coordinate switches so that there are no pauses in compressions.

5. Set up the defibrillator as soon as it arrives.

1. Attach a set of pads to the defibrillator cable. If the paddles are attached when the defibrillator arrives, these will need to be detached first.
2. Place the pads on the patient. Pad positions are illustrated on the pads themselves, though there are several options for positioning. The most common options are:
 1. Anteroposterior: Pads are placed on the left precordium and left back upper back. The patient will need to be rolled to place the posterior pad.
 2. Anterolateral: Place pads over the right sternal border and apex of the heart.
3. Turn on the defibrillator.

6. Analyze the rhythm.

The instructions below assume that the defibrillator is being used in manual mode. For automated defibrillators, follow the instructions provided by the machine.

1. Stop chest compressions to reveal the underlying rhythm, as compressions create electrical interference that will make it impossible to interpret the rhythm.
2. Determine if the rhythm is shockable. The two shockable arrest rhythms are ventricular fibrillation and ventricular tachycardia.
 1. Ventricular fibrillation is a randomly fluctuating pattern without organized QRS complexes. There is no predictability or pattern to it whatsoever.
 2. Ventricular tachycardia is a rapid, wide-complex rhythm, usually more than 150 beats per minute. The QRS complexes are so wide that one just segues into the next, without discernible T-waves.
3. If the rhythm is not shockable, resume chest compressions for two minutes, at which time the rhythm should be rechecked.
 1. If the rhythm is shockable, resume chest compressions while preparing to deliver a shock.

7. Deliver a shock (for shockable rhythms only).

1. Make sure that the machine is set to the correct dose of electricity (200J for adults).
2. Press the "charge" button.
3. Wait until the defibrillator is fully charged. The high-pitched charging tone will get louder when the machine is ready.
4. Clear all personnel away from the patient and the bed - make sure that nobody is in physical contact with the patient.
5. Press the "shock" button.
6. The high-pitched tone will stop, and the patient will "jump," indicating that electricity was delivered successfully.

Resume CPR immediately after delivering the shock, and continue for two minutes before pausing again to reassess the rhythm. Notice that there has been no mention of ventilation, vascular access, or drugs up to this point. That is because these are lower-priority interventions, with less impact on cardiac arrest survival. In the first few minutes of resuscitation, the priorities are rapid recognition of arrest, initiation of high-quality chest compressions, and performance of defibrillation when indicated.

Summary

Quality CPR is absolutely essential to cardiac arrest survival, and must be perfected by all healthcare providers. Suboptimal CPR is regrettably quite common, and leads to poor survival outcomes. Pausing CPR inappropriately is a common mistake, and is particularly likely when providers incorrectly prioritize advanced interventions like intubation and vascular access over basic life support. Other common mistakes include inappropriate compression rate, inadequate compression depth, leaning on the chest between compressions, ventilating ineffectively, and hyperventilating. Even with perfect CPR, outcomes from cardiac arrest aren't great, with less than 10% survival among out-of-hospital adult arrest victims, and less than 33% in-hospital survival. However, quality CPR and rapid defibrillation are absolute prerequisites to survival, and widespread improvement of resuscitation performance by providers could potentially increase survival rates.