

CONTINUOUS CHEST COMPRESSION-CPR

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- **Back off on ventilation**
- **Pay attention to recoil**
- **Gasping after cardiac arrest**
- **Out-of-hospital bystander response to cardiac arrest**
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“The goal is to generate blood flow to the heart and the brain. This person is dead. If you do nothing, they are dead. All you can do is help them.”

---Bentley Bobrow M.D.

Recent studies have flagged three common errors in technique during the performance of cardiopulmonary resuscitation (CPR) that decrease blood flow to the heart and brain, worsen the chances for survival, and increase the chances for brain damage. They are excessive ventilation, incomplete chest wall recoil and interruption of chest compressions.

In the past 30 years, the rigidly followed CPR guidelines for the chest compression-ventilation ratio have had a nearly flat survival rate.¹ In the past 30 years, the rigidly followed CPR guidelines for the chest compression-ventilation ratio have had a nearly flat survival rate.¹ This has been true even after the “update” in 2000. Anyone who has assisted in an out-of-hospital resuscitation attempt using this ineffective method knows the tragic outcome intimately.

We now know that even mildly excessive ventilation rates and incomplete chest-wall recoil during CPR can be lethal. This, quite simply, is the reason for improvement in CPR by eliminating the mouth-to-mouth ventilations and using 100 uninterrupted compressions/minute, a proven method of resuscitation that results in:

- More efficient oxygen delivery to the heart and brain during cardiac arrest
- More successful responses to electroshock, and
- Better neurological outcomes for the future

Continuous Chest Compression-CPR (CCC-CPR) is the term used to describe, not just the bystander chest-compression-only portion, but also the professional resuscitation method of delivering 200 preshock compressions and delaying advanced airway placement.

The improvement in CPR had its beginnings in 2003 in Tucson, Arizona; in 2004 in the Rock and Walworth counties of Wisconsin; and in 2005 statewide in Arizona, where it has been shown if you survive, 80% of the time you have a good neurological outcome.

The 80% becomes more meaningful knowing that the Phoenix group has had **300% more survivors.**²

The CCR method is composed of 3 components.^{4,5} They are:

- 1) Continuous chest compressions for bystander resuscitation without mouth-to-mouth ventilation
- 2) A new EMT algorithm; and
- 3) Aggressive post-resuscitation care.

In this article we will address only bystander resuscitation with and without an automatic external defibrillator (AED). Lay rescuers and public safety officers may be more willing and able to perform chest compression only CPR.

BACK OFF ON VENTILATION

“The higher the pressure within the chest the lower the pressure of the blood within the coronary arteries and to the brain.”⁶

That’s a pretty simple statement and it’s all we need to feel comfortable backing off of ventilation and increasing the rate of cardiac compressions; otherwise the heart muscle and the brain will receive less oxygen. When ventilation rates and duration are increased, it becomes more difficult for venous blood to return to the right heart and for blood to be squeezed out of the heart and into the circulation against the pressure in the lungs. Additionally, when there is reduced blood flow to the lungs, over-ventilation causes a ventilation/perfusion mismatch and further compromises the delivery of oxygen to the heart and brain.⁶

PAY ATTENTION TO RECOIL

For an adult, compress the chest 1 ½ to 2 inches with a complete release to create recoil. With each chest-wall recoil, a small intrathoracic vacuum develops, promoting venous blood flow back into the chambers of the right heart. Most of the blood flow to the coronary arteries and perfusion into the myocardium (heart muscle) itself occurs during this key decompression phase.

Apply pressure straight down on the middle of the sternum, pressing the heart between the sternum and the spine and forcing the blood into the aorta and pulmonary artery. Have a firm surface under the victim’s chest. This is hard work, especially at 100 uninterrupted compressions/minute. However, you can rejoice that you don’t have to worry about mouth-to-mouth ventilation.

GASPING AFTER CARDIAC ARREST

For a short time immediately after cardiac arrest some victims can be seen to gasp. You may be inclined to think that the heart is still pumping and be dissuaded from activating

911 and beginning chest compressions promptly. Gasping represents minimal perfusion to the brain. There will be no pulse. Be aware that gasping is common during the first 3-4 minutes of cardiac arrest and is associated with increased survival.⁷ Do not delay CCR because of it. If an adult suddenly collapses and is NOT breathing NORMALLY, initiate chest compressions!

OUT-OF-HOSPITAL BYSTANDER RESPONSE TO CARDIAC ARREST^{2,7}

When no AED is at hand. Rub the sternum hard to check for responsiveness. If no response, get someone to call 911 and start 100 compressions/min without mouth-to-mouth ventilations. Do not stop for anything until the EMT team takes over from you. If you switch rescuers, do so without interruption of compressions. This will be demonstrated in the video.

When AED is at hand and you have seen the victim go down, if you are alone:

- Check the clock. You have a 5-minute window to use the AED to the best advantage for the victim.
- Get someone to call 911.
- Get the AED fast, and use it. This will be your best shot.
- If the wait for defibrillation goes beyond 5 minutes, the victim is in a less favorable phase. Deliver 200 chest compressions at 100/minute before you deliver the shock. The same applies if you don't know when the arrest occurred.
- **The rescuer should always be either following the AED commands OR delivering chest compressions.**

NO ROOM TO SLACK OFF

There's no room for slacking off on the compressions or allowing interruptions. Even with 100 compressions per minute, the perfusion of heart and brain is fragile at best and pauses will put the victim behind the curve. The 100/min is a little over 8 (8.3 to be exact) compressions every 5 seconds; tough to sustain without a partner. Significant rescuer fatigue sets in after only 1 minute; if at all possible, rotate rescuers frequently. The proper way to rotate rescuers is demonstrated in the video. **Check that 911 has been called. The victim cannot survive without defibrillation.**

This video was made for the Arizona Dept. of Health Services by Tyler Vadeboncoeur M.D. and Bently Bobrow M.D. Mayo Clinic Emergency Dept.



View How-to Mayo Clinic Video

CCC-CPR is easy to learn, easy to remember, and easy to do. [More...](#)

WHAT TO EXPECT FROM THE EMT TEAM

- Single shock is delivered rather than stacked shocks.
- Chest compression 100/min. is resumed immediately after a shock is delivered with no delay for post shock rhythm and pulse checks.
- Initial airway management is limited to an oral pharyngeal device and supplemental oxygen.
- In witnessed cardiac arrest, assisted ventilations and intubation are delayed until either return of spontaneous circulation or until three series of compressions/analysis/shock are completed.
- Early-administration epinephrine either IV or orally.²

Electrical phase (0-5 minutes). When the EMT team arrives with the defibrillator, the heart is in a very vulnerable state, having passed through what is called the electrical phase, during which defibrillation will be most successful.

Hemodynamic phase (>5 minutes). The next phase is the hemodynamic phase, during which the heart has used up its energy stores and will not respond well to defibrillation. Therefore, if the arrest has not been witnessed, you will have to assume that it has been longer than 5 minutes and proceed with 200 chest compressions at 100/minute before attempting defibrillation.

The person doing the compressions does not let up until the defibrillator is ready to be discharged. Do not lose focus when the EMT team takes over; watch the procedure. Remember (1) the need for 100 uninterrupted compressions/minute with good recoil, and (2) the disadvantages of ventilation. This has happened on your watch and it may be that CCR hasn't reached everyone.

ACKNOWLEDGEMENT

Many thanks to Bentley Bobrow M.D., for his in-depth review, corrections, and encouragement. Dr. Bobrow is Clinical Associate Professor, Emergency Medicine Department, Maricopa Medical Center and Medical Director of the Bureau of Emergency Medical Services & Trauma System, Arizona Department of Health Services

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mc/April 2009