



**The Research Review**  
by Kenny Navarro

10/26/2015

### AHA CPR guidelines: What the 2015 ACLS updates mean for EMS providers

In-depth insights into the expert recommendations for medications, airway insertion and confirmation, defibrillation and post-arrest care

The [2015 American Heart Association \(AHA\) Guidelines Update for Cardiopulmonary Resuscitation \(CPR\) and Emergency Cardiovascular Care \(ECC\)](#) is a science-based document that requires thousands of hours of work by some of the most respected resuscitation researchers in the world as well as a dedicated staff at the American Heart Association. One important announcement from the AHA released simultaneously with the new guidelines is a declaration that future updates will no longer occur at regular five-year intervals. Instead, the [AHA will transition to a web-based format](#) that will allow continuous updates. This will be extremely helpful in those instances where new science makes a recommendation obsolete soon after publication of a guidelines update and years before the next update is scheduled for release.

#### Focus on ACLS recommendations

This article focuses on the advanced cardiac life support recommendations only. Changes to the basic life support (BLS) level recommendations are presented in [this article](#).

In making changes and new recommendations, the AHA only reviewed advanced-level topics with significant new science available or those that addressed more controversial subject matter. In situations where no new evidence existed, there were no changes to the previous recommendations.

Although not a new recommendation, the [AHA continues to emphasize the importance of basic life support](#) during an advanced resuscitation attempt.

#### Oxygen during resuscitation

One controversial issue is whether rescuers should deliver high-flow oxygen during the resuscitation period. Evidence suggests increased harm associated with high-flow oxygen administration during the period immediately after the patient achieves ROSC [1-3], although other studies could not demonstrate this harm [4-8]. These studies, however, examined the effects of high-flow oxygen administration *after* the patient achieved ROSC, not while the patient was receiving CPR. Nevertheless, one observational human outcomes study did examine the effects of high-flow oxygen administration by EMS during the resuscitation attempt [9]. In that study, researchers found that increases in PaO<sub>2</sub> levels (partial pressure of oxygen in arterial blood) measured during ongoing chest compression (median collapse to ABG interval was 27 minutes) increased the rate of survival to hospital admission. A secondary outcome analysis revealed a trend toward improved neurological outcome for patients with higher PaO<sub>2</sub> levels, although the differences did not meet statistical significance. As a result and consistent with the 2010 guidelines, the AHA continues to recommend administration of high-flow oxygen during the resuscitation period when CPR is in progress.

#### End-tidal carbon dioxide monitoring

The 2010 guidelines recommended monitoring certain physiologic parameters during the resuscitation attempt, some of which are generally not routinely monitored in the prehospital environment, such as arterial relaxation pressure, arterial blood pressure, and central venous oxygen saturation. However, end tidal carbon dioxide (ETCO<sub>2</sub>) levels can be easily monitored in the field. Failure to maintain an ETCO<sub>2</sub> level greater than 10 mm Hg is strongly predictive of unsuccessful resuscitation [10-12].

The 2010 AHA guidelines recommended that resuscitation teams attempt to improve chest compression performance when the ETCO<sub>2</sub> level was below that 10 mm Hg threshold [13]. In 2013, an expert panel convened by the AHA recommended that during an attempted resuscitation, health care professionals titrate CPR performance to achieve an ETCO<sub>2</sub> reading greater than 20 mm Hg [14].

One new recommendation for 2015 is that EMS personnel should consider terminating resuscitation efforts when the team is unable to achieve an ETCO<sub>2</sub> reading greater than 10 mm Hg 20 minutes after intubation. However the AHA does not recommend using ETCO<sub>2</sub> readings as the sole criterion for making that decision. Additionally, the AHA advises against using any ETCO<sub>2</sub> value as a criterion for making a decision to terminate resuscitation in nonintubated patients.

#### Defibrillation

At the advanced level, the cardiac arrest algorithm remains almost completely unchanged from the 2010 version. Recommendations for defibrillation remain unchanged. Biphasic defibrillators are still preferred over monophasic devices. Single shocks are still preferred over multiple or stacked shocks.

The AHA continues to recommend that EMS providers deliver the manufacturer's recommended first energy dose. If that dose is unknown, deliver the maximum energy dose allowed by the machine. It is also reasonable to follow the defibrillator manufacturer's recommendations on energy levels for subsequent defibrillation attempts.

#### Advanced airway insertion

One issue that remains controversial is whether EMS personnel should insert an advanced airway during the resuscitation attempt when CPR is ongoing. Since 2010, there is still no conclusive evidence that advanced airway insertion of any type during the resuscitation attempt improves survival following cardiac arrest [15-21]. In fact, most of these studies actually show improved survival when patients do not receive an advanced airway.

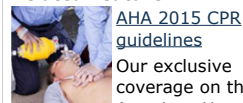
However, one criticism of any comparison between outcomes in patients who receive BVM-only ventilation and ventilation through an advanced airway is the selection bias inherent in this type of analysis. Patients who respond early to resuscitation efforts may never need advanced airway placement. On the other hand, patients with more severe hemodynamic and metabolic derangements may receive more advanced care. The AHA acknowledges that despite the attempt to control for this bias in many of these studies, the bias may still be present and will therefore limit the generalizability of the results.

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### **Ventilation assistance during resuscitation**

Regardless, the AHA recommends that rescuers provide assisted ventilation during the resuscitation attempt with either a BVM or an advanced airway, with no recommendation of a preference between an endotracheal or a supraglottic tube. This recommendation did not change from the 2010 guidelines.

### **Airway confirmation**

If rescuers manage the airway with an endotracheal tube, the AHA continues to recommend waveform capnography in addition to clinical assessment as the most reliable method of confirming proper placement and for ongoing tube surveillance. If waveform capnography is not available, the AHA states it is reasonable for health care providers to use colorimetric or nonwaveform generating capnometers, esophageal detector devices, or ultrasound as a confirmation alternative to waveform capnography.

Because no one has studied carbon dioxide monitoring devices with other methods of advanced airway management, there are no new recommendations related to the use of waveform capnography with supraglottic airways. However, the AHA acknowledges that when properly placed, ventilation through a supraglottic airway should produce a waveform similar to that seen with ventilation through an endotracheal tube.

### **Ventilation rate**

After placing an advanced airway, the AHA continues to recommend a ventilation rate of 10 breaths per minute (one every six seconds) while providing continuous chest compressions.

### **Epinephrine and vasopressor administration**

Arguably, the most anticipated guidelines recommendations centered on what medications would survive the science review process. Specifically, health care providers wondered what role vasopressor and antiarrhythmic drugs play in resuscitation following cardiac arrest.

For the 2015 guidelines, the science review teams reviewed two different vasopressors for cardiac arrest, epinephrine and vasopressin. Since publication of the previous guidelines, three published studies specifically addressed epinephrine use in cardiac arrest. The first was a double-blind placebo controlled trial conducted in the out-of-hospital environment [22]. Results from that investigation showed patients who received epinephrine had an increase in ROSC and survival to hospital admission. However, due to some administrative issues, the study was stopped early and, as a result, there were not enough patients enrolled to demonstrate improved long-term outcomes.

The other two investigations were both observational studies involving out-of-hospital cardiac arrest. One large study involving more than 417,000 patients found the prehospital use of epinephrine was associated with an increased chance of achieving ROSC before the patient arrived at the hospital, but a decreased chance of survival to one-month after discharge with good functional outcome [23]. The results of the other study could not demonstrate any improvements in ROSC, survival to hospital admission, survival to hospital discharge, or good neurological recovery [24].

As a result, the AHA did not alter its 2010 recommendation that it is reasonable to administer 1 milligram of epinephrine every 3-5 minutes for patients in cardiac arrest. There is no new evidence of a benefit of administering high-dose epinephrine and the AHA still does not recommend that dose for routine use in cardiac arrest.

Previous guidelines recommended the substitution of vasopressin for the first or second dose of epinephrine in cardiac arrest regardless of the presenting rhythm. Only one study has compared vasopressin alone to epinephrine alone [25]. Those researchers could find no differences in the rates of ROSC, 24-hour survival or survival to hospital discharge between the two groups.

In many studies comparing the two drugs, patients receive a single dose of vasopressin or epinephrine followed by additional doses of epinephrine effectively creating two groups, an epinephrine alone group and a vasopressin plus epinephrine group. Since publication of the 2010 guidelines, one randomized controlled trial studied these two groups [26]. The addition of vasopressin to standard drug therapy did not improve survival to hospital discharge. Based on all evidence to date, the AHA has removed vasopressin from the cardiac arrest algorithms.

Before leaving the discussion on the appropriate use of vasopressor therapy during cardiac arrest, it is important to note the issue of timing. Looking at the ventricular fibrillation or pulseless ventricular tachycardia (VF/pVT) side of the cardiac arrest algorithm, one can see that epinephrine administration does not occur until after the second shock. This remains unchanged from the 2010 guidelines. There is no evidence that early epinephrine administration is beneficial for patients presenting in a shockable rhythm. The AHA acknowledges there is insufficient evidence to make a recommendation on the optimal time health care providers should administer the first dose of epinephrine in shockable rhythms.

On the nonshockable side of the algorithm, epinephrine administration begins as soon as one achieves vascular access. Three studies have examined the issue of timing in the out-of-hospital environment. Compared to no epinephrine administration, survival to hospital discharge and intact neurologic survival improved when EMS personnel administered epinephrine within 10 minutes of EMS-initiated CPR [27]. Compared to later epinephrine administration, survival to one-month post discharge improved when EMS personnel administered epinephrine within nine minutes of EMS-initiated CPR [28]. In a study of pulseless electrical activity, epinephrine administered within 10 minutes of the 911 call resulted in improved ROSC rates [29].

The AHA believes it is reasonable to deliver the first dose of epinephrine as soon as feasible for nonshockable arrest rhythms.

### **Antiarrhythmic administration**

The AHA examined four medications for use as the first-line antiarrhythmic for shock-refractory VF/pVT; amiodarone, lidocaine, procainamide, and magnesium sulfate. None of these medications have proven effective in increasing long-term survival or improving neurological outcome following cardiac arrest due to VF/pVT.

Based on short term survival advantages, amiodarone continues to be recommended as the first-line antiarrhythmic agent for shockable rhythms refractory to CPR, defibrillation and vasopressor therapy [30,31]. Lidocaine is still an acceptable alternative to amiodarone. Since the 2010 guidelines made no recommendations about the use of procainamide as a first-line agent for refractory shockable rhythms and since no evidence is available, the AHA makes no new recommendations about procainamide in this context.

The AHA continues to recommend magnesium sulfate for the treatment of torsades de pointes or hypomagnesemia, but the drug is not recommended for routine use in cardiac arrest from VF/pVT.

### **Steroid administration**

Two out-of-hospital investigations examined the role of steroids in the management of cardiac arrest. During the arrest period, corticosteroids may enhance the vasopressor effects of both vasopressin [32] and epinephrine [33]. Although one study did find improved ROSC rates associated with the addition of a steroid to the standard management of out-of-hospital cardiac arrest [34], neither study could find a long-term survival benefit associated with the drug [35]. The exact role of steroids in the management of out-of-hospital cardiac arrest remains uncertain.

However, when compared to epinephrine and placebo, two hospital studies found improved survival to hospital discharge when clinicians administered a combination of vasopressin, epinephrine and methylprednisolone during the arrest along with hydrocortisone given after achieving ROSC if the patient developed shock [36,37]. Although this combination of medications is not recommended for the management of out-of-hospital cardiac arrest, health care providers managing an in-hospital cardiac arrest can consider administering the drugs.

### Post-cardiac arrest care

With a few notable exceptions, changes to recommendations for the post-cardiac arrest phase are minor, especially for those that could directly affect out-of-hospital care. Once the patient achieves ROSC, one of the priorities highlighted in the 2010 guidelines was to optimize the patient's hemodynamic status. Although the 2010 cardiac arrest algorithm lists a target of 90 mm Hg, the actual recommendation at the time was to achieve a mean arterial pressure (MAP) of at least 65 mm Hg.

In preparing for the 2015 guidelines, the research review team could find no evidence of an optimal blood pressure target. Therefore, the AHA believes it is reasonable to avoid and correct any hypotension (defined as a systolic blood pressure less than 90 mm Hg or a MAP less than 65 mm Hg) present during the post-resuscitation phase.

The AHA examined the prophylactic use of two antiarrhythmic agents following successful termination of VF/pVT. One observational study demonstrated increased survival rates associated with the oral or intravenous administration of beta-blocking agents during the in-hospital phase of care [38]. Although this study was reviewed before publication of the 2010 guidelines, the experts at that time believed the evidence neither supported nor refuted the routine use of any prophylactic antiarrhythmic agent during the post-resuscitation period.

A new recommendation for 2015 however is for health care providers to consider the administration of oral or intravenous beta blockers early after admission into the hospital following cardiac arrest due to VF/pVT. This recommendation does not extend to the out-of-hospital environment.

The second prophylactic antiarrhythmic medication examined was lidocaine. Since publication of 2010 Guidelines, one observational study conducted in the prehospital environment used two different methods of data analysis to examine the effects of prophylactic lidocaine during post-resuscitation care [39]. One method (multivariate analysis) demonstrated an association between prophylactic lidocaine administration during the post-cardiac arrest period and reduced odds of re-arrest from either VF/pVT or nonshockable rhythms, improved survival to hospital admission rates, and improved survival to hospital discharge rates. However, using the second analysis method (propensity score-matched sensitivity analysis), the only demonstrated benefit was a reduction in re-arrest from VF/pVT. Therefore, the AHA changed the recommendation on prophylactic antiarrhythmic administration to state that health care providers can consider administering lidocaine once the patient achieves ROSC following VF/pVT.

### Targeted temperature management

The AHA made several new recommendations related to targeted temperature management, often referred to simply as therapeutic hypothermia. The AHA upgraded the strength of recommendation to the highest level for using targeted temperature management in all comatose patients who achieve ROSC regardless of the presenting rhythm or whether the arrest occurred in the out-of-hospital or hospital environment. The AHA also expanded the targeted temperature range to 32 C to 36 C.

One very important new recommendation is for EMS to no longer initiate the cooling process with chilled saline infusion. Five randomized controlled trials using chilled IV fluids following ROSC [40-44], one trial using chilled IV fluids during the resuscitation attempt [45], and one trial using intra-nasal cooling [46] could find no survival or neurological recovery benefits offered by prehospital cooling. In one of the chilled saline trials, initiating cooling in the field actually increased the risk of re-arrest and post-resuscitation pulmonary edema [44].

Finally, consistent with the recommendation related to oxygen administration during the arrest period, the AHA recommends that if there is no reliable way to monitor oxygen saturation, health care providers should use high-concentration oxygen during the post-resuscitation period for assisted ventilation. However, if reliable oxyhemoglobin saturation measurement is available and is 100 percent, it is reasonable to decrease delivered oxygen concentration to achieve a saturation value of at least 94 percent.

Overall, advanced cardiac life support changes in the 2015 American Heart Association Guidelines Update for Cardiopulmonary Resuscitation and Emergency Cardiovascular Care are relatively minor. There are still many unanswered questions about the role that advanced life support plays in resuscitation from out-of-hospital cardiac arrest. In fact, anyone who wishes to submit a question for possible future science review can do so by using the [ILCOR Scientific Evidence Evaluation and Review System](#).

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