Advanced Cardiac Life Support: What’s New, What’s Old?

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Approximately 300,000 out-of-hospital cardiac arrests occur in the United States each year.1 The American Heart Association (AHA) supports implementation of the “chain of survival” to rescue people who experience cardiac arrest in the community. The “chain of survival” consists of early recognition and emergency activation (phone 9-1-1), CPR, defibrillation, and advanced care. Advanced Cardiac Life Support (ACLS) encompasses elements designed to increase survival in patients who experience sudden cardiac death. ACLS provides recommendations to trained providers regarding optimizing circulation, airway management, cardiac rhythm management via defibrillation and/or administration of medications, and stabilization of the patient’s condition.2

History of ACLS

The first published guidelines for the management of patients via ACLS protocols were developed in 1973 and published in 1974. Those guidelines were cosponsored by the AHA and the National Research Council. The guidelines have changed significantly since their inception in 1973. In 1974, the algorithms we have grown accustomed to did not exist. Drugs were listed as “essential agents” or “useful agents” and then were described according to their potential roles in treatment.2 As the years progressed, more agents were added to the guidelines.3 The 1986 guidelines introduced basic algorithms with an emphasis on obtaining intravenous (IV) access and administration of drugs. The algorithms incorporated early establishment of IV access, administration of drugs, and defibrillation.3 Intubation was recommended as an adjunct to these interventions. The early administration of drugs was emphasized because the patient could be ventilated without intubation.

In 1992, the ACLS guidelines decreased emphasis on the value of medications in cardiac resuscitation. The review of evidence led to a reduction in indications for agents such as calcium chloride, sodium bicarbonate, epinephrine, and isoproterenol.5 The updated guidelines in 2000 also followed this approach. Priorities were placed on basic CPR, defibrillation when indicated, and proper airway management. Drugs could be used in situations where they might be useful after the initial steps were started.6 The 2005 guidelines had some differences from previous versions of the guidelines as well. These guidelines were designed to streamline material and reduce the amount of information that needed to be learned and remembered to successfully manage patients. Algorithms were easier to comprehend and remember. In addition, they highlighted the essential assessments and interventions for providers.7 The 2010 guidelines represented a similar approach and now include a circular algorithm as opposed to the box and line format. The 2010 guidelines are based on the most current review of the literature, and each edition is updated to reflect current best practice.8

Algorithms

The cardiac arrest algorithms include ventricular fibrillation (VF), pulseless ventricular tachycardia (VT), pulseless electrical activity (PEA), and asystole. In both witnessed and unwitnessed cardiac arrest, CPR with chest compressions should be initiated immediately and continued while a defibrillator is obtained. When VF/pulseless VT is identified, a shock should be delivered as soon as possible. Immediately following defibrillation, chest compressions should be initiated and continued for 2 minutes without delay for rhythm assessment or pulse check. Medications used in persons with VF/pulseless VT include a vasopressor (epinephrine or vasopressin) and amiodarone. If a rhythm
check reveals PEA/asystole or nonshockable rhythms, CPR should be continued with the utilization of a vasopressor (epinephrine or vasopressin). The 2010 AHA cardiac arrest guidelines stress the importance of high-quality chest compressions, rapid defibrillation for persons with VF/pulseless VT, and the use of the following core medications: epinephrine, vasopressin, and amiodarone to aid in the return and maintenance of a perfusing rhythm.9

Vasopressors
Although no studies have shown that vasopressors increase the rate of neurological intact survival, their use has been linked with increased rates of return of spontaneous circulation.

Epinephrine
Epinephrine is a sympathomimetic catecholamine that stimulates both α and β receptors. Epinephrine’s α effects cause vasoconstriction and increase coronary and cerebral perfusion pressures. Through its actions on β1 receptors in the myocardium and pacemaker cells in conducting tissue, epinephrine serves as a direct cardiac stimulant, although its β effects may increase myocardial work and reduce perfusion. The recommended dose of epinephrine in cardiac arrest is 1 mg every 3 to 5 minutes (class IIb, level of evidence [LOE] A).9

Vasopressin
Vasopressin is a potent vasoconstrictor that increases blood pressure and systemic vascular resistance. Its vasoconstrictive properties are primarily due to its effects on the V1 receptor on vascular smooth muscle cells. Vasopressin may be effective in restoring cardiovascular function after cardiac arrest. The AHA guidelines recommend one dose of vasopressin (40 units) as alternative therapy to replace the first or second dose of epinephrine in the treatment of cardiac arrest (class IIb, LOE A).10

Antiarrhythmic agents
AMIODARONE
Amiodarone has effects consistent with all 4 Vaughan Williams antiarrhythmic drug classes but is classified as a class III antiarrhythmic drug. Its pharmacological effects include the blockade of sodium, potassium, and calcium channels, as well as noncompetitive α and β-adrenergic blockade. Randomized controlled studies have demonstrated improvement in hospital admission rates in patients with VF/pulseless VT who had amiodarone administered by paramedics.10 Use of amiodarone as the first-line antiarrhythmic agent should be considered in persons with VF/pulseless VT who are unresponsive to CPR, defibrillation, and vasopressor therapy because of the increased short-term survival to hospital admission in persons who receive amiodarone (class IIb, LOE A).9 The recommended dosing of amiodarone is an initial dose of 300 mg, which can be followed by a one-time dose of 150 mg.

Interventions No Longer Recommended for Routine Use in Cardiac Arrest
ATROPINE
Atropine is an anticholinergic agent that competes with acetylcholine and other muscarinic agonists for a common binding site on the muscarinic receptor. Its blockade of the actions of acetylcholine results in alteration in heart rate, predominantly seen as tachycardia without affecting blood pressure or cardiac output. Previously, atropine was considered in the cardiac arrest algorithm for asystole or slow PEA rate because of its ability to reverse cholinergic-mediated decreases in heart rate and atrioventricular nodal conduction. Although evidence suggesting detrimental effects is lacking, in its most recent guidelines for CPR and emergency cardiovascular care, the AHA reports that the routine use of atropine is unlikely to have a therapeutic benefit based on the available evidence. However, atropine is still the drug of choice for acute symptomatic bradycardia (class IIa, LOE B).

Other Drug Delivery Methods
Ideally during a cardiac arrest, medications should be given intravenously. Central IV administration produces higher drug concentrations with shorter circulation times in comparison with peripheral IV administration. Administration of medications peripherally should be followed by a bolus of fluid to aid their delivery into the central circulation. If IV access cannot be obtained quickly, medications also may be given interosseously (IO) or via the endotracheal (ET) tube. IO administration produces similar pharmacokinetic effects as peripheral administration, and all ACLS medications can be given via this route. ET drug delivery produces lower drug concentrations in the blood but is an option for vasopressin, epinephrine, and lidocaine administration. If IV or IO access cannot be obtained and the ET tube is used, the medication dose should be increased 2 to 2.5 times the IV dose.

AHA Levels of Evidence
The LOE (A,B,C) classify the size of the population showing the treatment effect or the certainty with which the effect can be seen.11 Level A correlates with evaluation of a large population (eg, randomized clinical studies or meta-analyses),
whereas level C is associated with expert opinion, case studies, or standard of care with assessment of a very limited population. The classes (I, IIa, IIb, and III) categorize the risk versus benefit seen in the studied population. Class I recommendations should be recommended because the benefits clearly outweigh the risks. Additional studies are needed for class II recommendations, but they are reasonable options (IIa) or may be considered (IIb). Class III evidence suggests that the risk outweighs the benefit and is not recommended.

Conclusion
The recommendations in resuscitation science are constantly advancing. Each edition for the AHA Guidelines for CPR and Emergency Cardiovascular Care marks improvement and enhancement of the care of patients. As new evidence emerges, the guidelines will adapt and evolve. Current training of ACLS providers requires recertification every 2 years to keep health care providers up to date on the latest recommendations. The guidelines appear to be updated approximately every 5 years, so we are not likely to see another edition until 2015.

REFERENCES

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