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EDITORIAL

The New Guidelines for Cardiopulmonary Resuscitation

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ABSTRACT

In the new (2010) cardiopulmonary resuscitation (CPR) guidelines, and for adult victims of out-of-hospital cardiac arrest, the four pillars of resuscitation are the immediate recognition of cardiac arrest and activation of the emergency response system, early performance of high quality bystander CPR simplified to include chest compressions alone (*cardiocerebral resuscitation-CCR*, which seems comparable to conventional CPR) and early defibrillation. To effect the latter, integration of *automatic external defibrillators (AEDs)* into a system of emergency care is critical in the Chain of Survival in public places outside the hospitals. Organized post– cardiac arrest care is the new fifth link in the chain of survival, with an emphasis on multidisciplinary programs that focus on optimizing hemodynamic, neurologic, and metabolic function, including therapeutic hypothermia and early primary percutaneous intervention in cardiac arrest victims suffering from an acute myocardial infarction, which may improve survival to hospital discharge for those who achieve recovery of spontaneous circulation following cardiac arrest.

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KEY WORDS: *cardiac arrest; cardiopulmonary resuscitation; resuscitation guidelines; automatic external defibrillators; acute coronary syndromes; acute myocardial infarction; ventricular fibrillation*

ABBREVIATIONS
ACLS = advanced cardiac life support
ACS = acute coronary syndrome
AED = automatic external defibrillator
BLS = basic life support
CCR = cardio-cerebral resuscitation
CPR = cardiopulmonary resuscitation
DNAR = do-not-attempt resuscitation
EMS = emergency medical system
OOHCA = out-of-hospital cardiac arrest
PCI = percutaneous cardiac intervention
RCT = randomized controlled trial
ROSC = return of spontaneous circulation
VF = ventricular fibrillation
VT = ventricular tachycardia

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The International Liaison Committee on Resuscitation (ILCOR) and the American Heart Association (AHA) recently published the new (2010) guidelines for cardiopulmonary resuscitation in both the *Circulation* and *Resuscitation* medical journals.[1,2] The ILCOR Universal Cardiac Arrest Algorithm was updated (Figure 1). The intention was to have this algorithm applied to attempted resuscitation of infant, child, and adult victims of cardiac arrest (excluding newborns). Efforts have aimed to keep this algorithm simple, yet make it applicable to treatment of cardiac arrest victims of all ages and in most circumstances.

Among the developments from the previous (2005) guidelines we highlight the following. First, the new guidelines recommend a change in the basic life support (BLS) sequence of steps from "A-B-C" (Airway, Breathing, Chest compressions) to "C-A-B" (Chest compressions, Airway, Breathing) for adults and pediatric patients (children and infants, excluding newborns). By changing the sequence from A-B-C to C-A-B, chest compressions will be commenced sooner and ventilation only slightly delayed until completion of the first cycle of chest compressions (30 compressions should be completed in approximately 18 seconds). Fewer than 50% of persons in cardiac arrest receive bystander CPR. There are probably many reasons for this, but one main obstacle may be the A-B-C sequence, which starts with the procedures that rescuers find most difficult: opening the airway and delivering rescue breaths. Starting with chest compressions might ensure that more victims receive CPR and that rescuers who are unable or unwilling to provide ventilations will at least perform chest compressions.

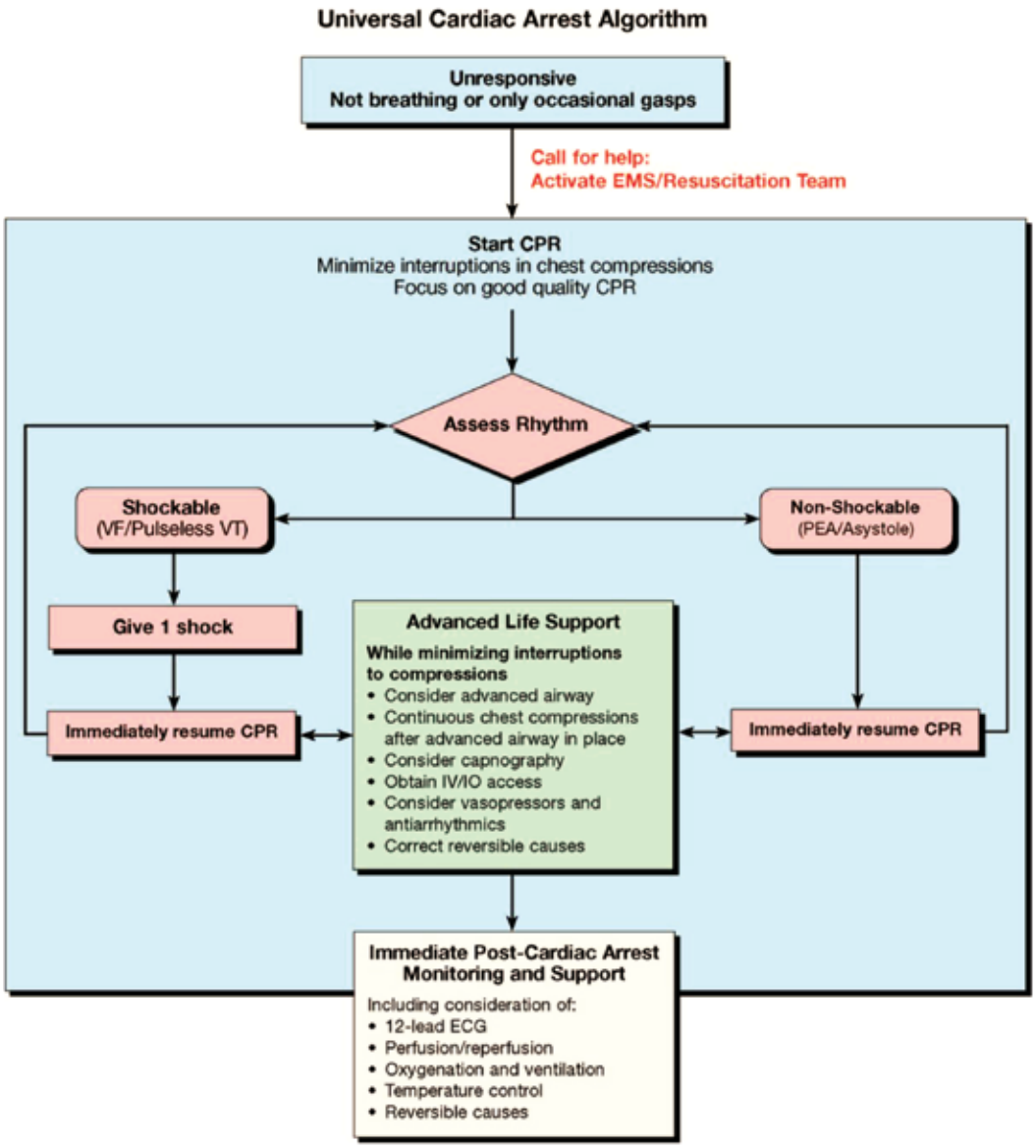

Figure 1. The universal Cardiac Arrest algorithm[1,2].

The four pillars of resuscitation comprise immediate **recognition** of sudden cardiac arrest and **activation** of the emergency response system, early performance of **high quality CPR**, and rapid **defibrillation** when appropriate.

At first, recognizing the victim of cardiac arrest is crucial. When the health care provider sees a victim suddenly collapse, the provider may assume that the victim has suffered a sudden VF cardiac arrest; once the provider has verified that the victim is unresponsive and not breathing or is only gasping, the provider should immediately activate the emergency response system, get and use an AED, and give CPR. However, for a presumed victim of drowning or other likely asphyxial arrest the priority would be to provide about 5 cycles (about 2 minutes) of conventional CPR (including rescue breathing) before activating the emergency response system. Also, in newly born infants, arrest is more likely to be of a respiratory etiology, and resuscitation should be attempted with the A-B-C sequence unless there is a known cardiac etiology. For the lay rescuer it is recommended that there should be no attempt to check for a pulse and should assume that cardiac arrest is present if an adult suddenly collapses, is unresponsive, and is not breathing or not breathing normally (i.e., only gasping).

The new guidelines do recognize the impact of bystander CPR on survival after out-of-hospital cardiac arrests and in order to effect its wider implementation they simplify CPR recommendations stressing at the same time the crucial im-

portance of high-quality CPR. The BLS algorithm has been simplified by omitting the "Look, Listen and Feel" step in the algorithm and proceeding to immediate activation of the emergency response system and starting chest compressions for any unresponsive adult victim with no breathing or no normal breathing (i.e., only gasps). A recent meta-analysis of three randomized trials showed that chest-compression-only CPR was associated with improved survival compared with standard CPR (14% [211/1500] vs 12% [178/1531]; risk ratio 1.22).[3] The absolute increase in survival was 2.4%, and the number needed to treat was 41.

In adult patients the critical initial elements of CPR are chest compressions and early defibrillation. Thus,

- For adults with out-of-hospital cardiac arrest, bystander CPR with ***chest compression alone*** (*cardiocerebral resuscitation-CCR*)[3-13] seems to be comparable to conventional CPR (compressions with rescue breathing). However, for children, and other special groups (e.g. drowning, trauma or asphyxia) conventional CPR is superior.
- A universal compression-ventilation ratio of 30:2 performed by lone rescuers for victims of all ages

The changes in the compression-ventilation ratio and in the defibrillation sequence (from 3 consecutive shocks to 1 shock followed by immediate CPR) were recommended to minimize interruptions in chest compressions. Thus, minimizing the interval between stopping chest compressions and delivering a shock (i.e., minimizing the preshock pause) improves the chances of shock success and patient survival.

Stronger emphasis is given on compressions of adequate rate and depth, allowing complete chest recoil after each compression, minimizing interruptions in compressions and avoiding excessive ventilation. The recommended depth of compression for adult victims has increased from a depth of 1 1/2 to 2 inches to a depth of at least 2 inches (5 cm). The quality of rescuer education and frequency of retraining are critical factors in improving the effectiveness of resuscitation.

Organized post– cardiac arrest care with an emphasis on multidisciplinary programs that focus on optimizing hemodynamic, neurologic, and metabolic function (including therapeutic hypothermia[14]) may improve survival to hospital discharge among victims who achieve ROSC following cardiac arrest either in- or out-of-hospital. ***Therapeutic hypothermia***[14,15] is one intervention that has been shown to improve outcome for comatose adult victims of witnessed out-of-hospital cardiac arrest when the presenting rhythm was VF. Community and hospital-based resuscitation programs should systematically monitor cardiac arrests, the level of resuscitation care provided, and outcome.

ELECTRICAL THERAPY

Integration of ***automatic external defibrillators (AEDs)*** into a system of emergency care is critical in the Chain of Survival in public places outside the hospitals.[16] To give the victim the best chance of survival, 3 actions must occur within the first moments of a cardiac arrest: activation of the emergency medical services system, provision of CPR, and operation of a defibrillator.

In the case that 2 rescuers are available, one starts CPR while the other one obtains and prepares a defibrillator to be used. The 1-shock protocol for VF is recommended and interruptions in CPR to deliver the shock should be very brief and CPR should be immediately resumed after shock delivery.

ADVANCED CARDIAC LIFE SUPPORT (ACLS)

Good BLS is crucial for the success of ACLS. It starts with prompt high-quality CPR with minimal interruptions, and for VF/pulseless VT, defibrillation should be delivered within minutes of collapse. A new fifth link in the Chain of Survival has been added, "Post–Cardiac Arrest Care", emphasizing the importance of multidisciplinary care that starts with recognizing cardiac arrest and continues after recovery of spontaneous circulation (ROSC) through hospitalization and after discharge. The objectives of post– cardiac arrest care comprise optimization of cardiopulmonary function and vital organ perfusion after ROSC, transportation to an appropriate hospital or critical-care unit, identification and intervention for acute coronary syndromes (ACS),[17] early management of acute ischemic stroke, therapeutic hypothermia to optimize neurologic recovery,[14,15] watchful monitoring for and management of multiple organ dysfunction. Patients with ACS should be managed aggressively and triaged to a facility with PCI capability.[17,18] Patients with acute stroke should be triaged directly, if possible, to special stroke centers (new Class I recommendation), and admitted to dedicated stroke units within 3 hours of arrival in the emergency department, where fibrinolysis or mechanical revascularization can be accomplished. For airway management the use of quantitative waveform ***capnography*** for confirmation and monitoring of endotracheal tube placement is new Class I recommendation for adults.[1,2]

For arrhythmia management, intravenous (IV) *adenosine* can be employed for the differential diagnosis and treatment of stable monomorphic wide-complex tachycardia. For severe bradycardia, IV infusion of *dopamine or epinephrine or isoproterenol* is now recommended as an equally effective alternative to external pacing when atropine is ineffective. Atropine is no longer recommended for routine use in the management of pulseless electrical activity (PEA)/asystole. Emphasis is given on high-quality CPR with minimal interruptions, while delivering drugs or DC shock, or obtaining vascular access, or placing an airway; all these maneuvers should not delay the

delivery of a shock when appropriate.

ETHICAL ISSUES

The ethical issues surrounding resuscitation are complex and vary in different settings, countries and cultures. It seems that in addition to the current standard written, signed, and dated do-not-attempt resuscitation (DNAR) document, acknowledgment of a verbal DNAR order may decrease the number of resuscitation attempts exercised in vain. There is variability in rules and protocols for terminating resuscitation efforts across health systems and physicians and establishing guidelines is a most difficult task. As there is a growing need for transplant tissue and organs, all provider teams who treat post-cardiac arrest patients should also plan and implement a system of tissue and organ donation which should be supportive of family members.

SPECIAL SITUATIONS

Cardiac arrest in special situations may require special treatments or procedures. The new guidelines cover 15 such special situations, such as asthma, anaphylaxis, pregnancy, morbid obesity, pulmonary embolism, electrolyte disturbances, ingestion of toxic substances, trauma, accidental hypothermia, avalanche, drowning, electrocution, and special procedural situations affecting the heart, including PCI, cardiac tamponade, and cardiac surgery. Specific topics which are extensively covered also include acute coronary syndromes and acute stroke, as well as pediatric and neonatal life support. Finally, first aid is also detailed in these new guidelines, for example use of tourniquets to control bleeding, treatment of jelly fish stings, pressure immobilization for snake bites, first aid treatment for frostbite, oral fluid replacement for exercise- or heat-induced dehydration, etc.

DISMAL SURVIVAL OF OOHCA & LIMITED EVIDENCE-BASE FOR RESUSCITATION GUIDELINES

Despite the renewal and update of resuscitation guidelines every 5 years, the percentage of OOHCA victims surviving to hospital discharge is limited to 1.4-8% in the US[19-22] and probably 0-10% in Europe.[23] Only a limited number of randomized clinical trials (RCTs) deal with the resuscitation protocols for victims of OOHCA, compared to the number of RCTs in other areas, such as myocardial infarction, stroke or heart failure.[19]

Important prognosticators of survival in patients with OOHCA are witnessed collapse leading to early bystander-initiated CPR and a shockable heart rhythm responding to early delivery of defibrillation with use of an AED. Of course, shorter EMS response times are of paramount importance in a well-organized community.

For communities, areas to work on that can improve these dismal statistics include:

- public education to recognize cardiac arrest victims
- public education to deliver bystander CPR, now simplified to *cardiac compressions alone (CCR)*
- wider availability of AEDs and education of public and health care providers to use them[16]
- improvement in EMS delivery with shorter response times to calls for cardiac arrest
- applying therapeutic hypothermia to decrease the effects of hypoxic encephalopathy and reduce brain injury[14,15]
- early primary PCI in cardiac arrest victims suffering from an acute myocardial infarction[17,18]
- following the updated guidelines which emphasize, among other things detailed above, the importance of good quality CPR with minimal interruptions and rapid early defibrillation.

Finally, encouraging and financing randomized controlled trials (RCTs) in the area of resuscitation would provide further evidence-based data to support progress and improvements in delivery of more effective resuscitation protocols.

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