Cardiopulmonary Resuscitation Quality Issues

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KEYWORDS

• Cardiac arrest • Cardiopulmonary resuscitation • Out-of-hospital cardiac arrest
• Emergency medical services • Heart massage

KEY POINTS

- Much of the current evidence and many of the recent treatment recommendations for increasing survival from cardiac arrest revolve around improving the quality of cardiopulmonary resuscitation during resuscitation.
- A focus on providing treatments that are proved beneficial and providing these treatments reliably, using measurement, monitoring, and implementation of quality-improvement strategies, will help to eliminate variation in outcomes and provide a foundation from which future improvements in resuscitation care can be developed.
- Using the knowledge and tools available today will help reduce the ambiguity and variability that exists in resuscitation today and provide the ability to save more lives in communities.

High-quality cardiopulmonary resuscitation (CPR) and defibrillation, if indicated, are the central interventions in the initial resuscitation from sudden cardiac arrest (SCA). Chest compressions, however, are often given either too slow or too fast or include inappropriate pressure on the chest during relaxation. Prolonged interruptions in compressions are frequent during resuscitation attempts.[1] Poor-quality CPR, with prolonged pauses for any cause, is associated with worse outcomes.[2] When external chest compressions and appropriate ventilation are provided effectively after collapse, it is possible to extend the prehospital treatment window for victims of SCA.[3]

The importance of providing high-quality compressions was not widely appreciated by either prehospital or hospital providers until the late 1990s. Treatment guidelines in the 1990s resulted in long pauses for ventilation and added lengthy interruptions in compressions to allow for performance of intubation, stacked shocks with frequent pulse checks, and medication administration. Emphasis on these treatments conveyed the perception that compressions were much less important than these other therapies.

It is now understood that poor compression quality can significantly affect perfusion and contributes to poor outcome.[2,4] With that realization and with a renewed focus on training to provide high-quality compressions, there is a growing awareness of the need to refocus on basic resuscitation components using strategies known to improve outcomes, particularly improving the quality of CPR, and the importance of having a well-coordinated system

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of care in a community.[5] This article reviews current evidence, recommendations, and best practices related to prehospital CPR quality.

CURRENT EVIDENCE

Current evidence regarding the effectiveness of CPR strategies is summarized by the International Liaison Committee on Resuscitation (ILCOR) in the form of their Treatment Recommendations (CoSTR).[6] These treatment recommendations form the basis of the guidelines disseminated by each of the ILCOR council members, including the American Heart Association (AHA), whose guidelines are consulted throughout North America. Recently, ILCOR has moved from holding a focused evidence review every 5 years to instituting a continuous evidence review and evaluating key resuscitation questions as evidence becomes available.

One of the limitations of treatment recommendations and subsequent guidelines arises from the low quality of available evidence for many advanced life support (ALS) treatments. Because there is a belief that clear guidelines are needed, many ALS treatment recommendations with low or very low evidence are strengthened by consensus of the experts and recommendations currently active are not changed without sufficient supporting evidence.

INTERNATIONAL LIAISON COMMITTEE ON RESUSCITATION TREATMENT RECOMMENDATIONS PERTINENT TO CARDIOPULMONARY RESUSCITATION QUALITY

Compression Rate

Chest compression rates have been shown to correlate with return of spontaneous circulation (ROSC), survival to discharge, and survival with favorable neurologic outcomes.[7] The recommended rate for compressions has increased since the initial version of the CPR guidelines, which were published in 1960 and recommended a rate of 60 compressions/min.[8] The 2010 AHA guidelines called for a rate of at least 100 compressions/min without specifying an upper limit.[4] Studies suggest that there is no benefit with regard to either ROSC or survival to discharge, when compressions are provided at the upper limit of 140 per minute.[8] The 2015 AHA guidelines reflect this evidence, stating that “it is reasonable” for compressions to be performed at a rate of 100 compressions/min to 120 compressions/min.[3] The ILCOR CoSTR recommendation states:

- We recommend a manual chest compression rate of 100 to 120/min (strong recommendation, very-low-quality evidence).[9]

Inappropriately fast compression rates may have deleterious effects due to inadequate time for filling of the heart between compressions and provider fatigue.[10,11]

Delivery of Chest Compressions

Several strategies have been proposed to attempt to optimize perfusion and/or to minimize/manipulate pauses during chest compressions. These methods include the provision of continuous compressions with asynchronous ventilation,[12] which showed no statistically significant difference in outcome when compared with conventional CPR. Another method is called minimally interrupted cardiac resuscitation (MICR), one strategy of which is called cardiocerebral resuscitation,[13] which consists of an initial series of cycles of uninterrupted chest compressions, passive ventilation, and before-and-after rhythm analysis with shock if appropriate. This cardiocerebral resuscitation strategy was studied in a large before and after trial comparing survival to hospital discharge in patients receiving standard advanced cardiac life support care versus those receiving minimally interrupted chest compressions in the prehospital setting. Survival to hospital discharge increased from 1.8% before MICR to 5.4% after MICR implementation.[13] Although this is an impressive improvement, it is unclear whether such a strategy would provide a similar effect in a system that had already had a survival rate at or above the Cardiac Arrest Registry to Enhance Survival (CARES) average of 10.8%.[14]

The newest of these delivery strategies currently being studied in an animal laboratory is a form of variable-rate CPR, sometimes referred to as stutter CPR.[15] This form of experimental CPR delivery is based on the concept of controlling pauses during CPR to invoke ischemic preconditioning mechanisms after SCA.

The 2015 treatment recommendations for chest compression from ILCOR include the following:

- EMS providers should perform CPR with 30 compressions to 2 ventilations or continuous chest compression with positive pressure ventilation delivered without pausing chest compressions until a tracheal tube or supraglottic device has been placed (strong recommendation, high-quality evidence).[9]
- For EMS systems that have adopted MICR, this strategy is considered a reasonable alternative