The Journal of Emergency Medicine, Vol. ■, No. ■, pp. 1–10, 2017

0736-4679/$ - see front matter

http://dx.doi.org/10.1016/j.jemermed.2017.08.065

Clinical Review

TEAM-FOCUSED CARDIOPULMONARY RESUSCITATION: PREHOSPITAL PRINCIPLES ADAPTED FOR EMERGENCY DEPARTMENT CARDIAC ARREST RESUSCITATION

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□ **Abstract—Background: Out-of-hospital cardiac arrest has high rates of morbidity and mortality, and a growing body of evidence is redefining our approach to the resuscitation of these high-risk patients. Objectives: Team-focused cardiopulmonary resuscitation (TFCPR), most commonly deployed and described by prehospital care providers, is a focused approach to cardiac arrest care that emphasizes early defibrillation and high-quality, minimally interrupted chest compressions while de-emphasizing endotracheal intubation and intravenous drug administration. TFCPR is associated with statistically significant increases in survival to hospital admission, survival to hospital discharge, and survival with good neurologic outcome; however, the adoption of similar streamlined resuscitation approaches by emergency physicians has not been widely reported. In the absence of a deliberately streamlined approach, such as TFCPR, other advanced therapies and procedures that have not shown similar survival benefit may be prioritized at the expense of simpler evidence-based interventions. Discussion: This review examines the current literature on cardiac arrest resuscitation. The recent prehospital success of TFCPR is highlighted, including the associated improvements in multiple patient-centered outcomes. The adaptability of TFCPR to the emergency department (ED) setting is also discussed in detail. Finally, we discuss advanced interventions frequently performed during ED cardiac arrest resuscitation that may interfere with early defibrillation and effective high-quality chest compressions. Conclusion: TFCPR has been associated with improved patient outcomes in the prehospital setting. The data are less compelling for other commonly used advanced resuscitation tools and procedures. Emergency physicians should consider incorporating the TFCPR approach into ED cardiac arrest resuscitation to optimize delivery of those interventions most associated with improved outcomes.** © **2017 Elsevier Inc. All rights reserved.**

□ **Keywords—advanced airway; cardiac arrest; cardiopulmonary resuscitation; extracorporeal membrane oxygenation; out-of-hospital cardiac arrest; point-of-care ultrasound; team-focused cardiopulmonary resuscitation**

Reprints are not available from the authors.

INTRODUCTION

More than 356,000 out-of-hospital cardiac arrests (OHCA) occur each year while overall risk-adjusted survival remains at a dismal 8.3% (1–3). Over the past decade, many clinical research reports have redefined our approach to cardiac arrest resuscitation, and over this time we have seen a slow trend toward improved outcomes (2). Prehospital medicine has led the charge for this revolution by emphasizing a standardized and simplified approach to cardiopulmonary resuscitation (CPR), focusing only on the most important interventions shown to improve patient-centered outcomes, including return of spontaneous circulation (ROSC), survival to hospital admission, survival to hospital discharge and, most importantly, survival with intact neurologic function.

RECEIVED: 27 February 2017; FINAL SUBMISSION RECEIVED: 31 July 2017;
ACCEPTED: 11 August 2017

Team-focused CPR (TFCPR) is one such cardiac arrest protocol used by prehospital providers in North Carolina. TFCPR is associated with statistically significant improvements in each of these patient-centered outcomes, yet its incorporation into emergency department (ED) resuscitation has not been widely reported (4,5). This review examines the evidence base for many commonly used cardiac arrest interventions, including those that may directly or indirectly interfere with early defibrillation or high-quality chest compressions. It also introduces the logistics of TFCPR and discusses the incorporation of TFCPR principles into an organized approach to cardiac arrest resuscitation in the ED.

DISCUSSION

Current CPR Guidelines

In the 2015 guidelines update for CPR and Emergency Cardiovascular Care, the American Heart Association (AHA) reaffirmed the two cornerstones of early cardiac arrest resuscitation as: 1) quality chest compressions, and 2) early defibrillation for shockable cardiac rhythms (6,7). Despite all we have historically done, these two intra-arrest interventions have been proven in clinical trials to have the most consistent and significant impact on improving patient-centered outcomes.

Recent trials from the Resuscitative Outcomes Consortium database have helped further define effective chest compressions as being performed at the rate of 100–120 compressions/min, with a chest compression depth of 2.0–2.4 inches and full chest recoil after each individual compression (8,9). The AHA also cautions against hyperventilation because the associated increase in intrathoracic pressure and gastric distension can further impede effective compressions (7). In addition, they recommend frequent compressor changes to avoid physical provider fatigue (7,10).

We now realize that chest compression fraction (proportion of time compressions are performed during cardiac arrest) is a critical and modifiable variable of high-quality CPR. The AHA's stated goal is for a chest compression fraction of ≥60%, meaning on average there should be <40% of intra-arrest time where compressions are withheld (7). In addition, two recent clinical trials report a survival benefit with increased chest compression fractions of ≥80%, both for out-of-hospital ventricular fibrillation arrest and nonventricular fibrillation arrest, respectively (11,12).

Specific interventions that have been proven (or proposed) to decrease chest compression fraction include vascular access attempts, advanced airway placement, and administration of intra-arrest medications (13–15). Unlike effective chest compressions, the benefits of these other interventions are debatable. This is especially important when we realize that alternative options are available in each of these circumstances. Intraosseous access (IO) is as effective as peripheral or central intravenous access (IV) in patients with cardiac arrest. IO can often be secured quicker than IV, and a lower extremity IO site does not directly interfere with effective chest compressions (14,15). Likewise, supraglottic blind insertion airway devices (BIAD) are often quicker to insert than endotracheal tubes. BIADs provide effective oxygenation and ventilation, are easily inserted without interrupting chest compressions, and are reported to have a lower complication rate than rapid sequence endotracheal intubation (ETI) (16).

Finally, the duration of the perishock pause surrounding defibrillation is directly correlated to outcomes. Independent of overall chest compression fraction, perishock pauses in compressions of >20 s are associated with significantly decreased survival (17). One tactic to minimize the perishock pause is to begin charging the defibrillator during ongoing compressions (18). This tactic ensures that the defibrillator is ready to immediately deliver a shock before performing the pulse check between compression cycles. Pulse check and rhythm analysis can then be simultaneously performed, and shock delivered without delay if a shockable rhythm is identified. Chest compressions can then be resumed immediately, with a goal perishock pause of <10 s. This technique is growing in popularity, and was proven effective in a 2010 clinical trial without any increased incidence of inadvertent shocks (18,19).

Hands-on defibrillation, where chest compressions are continued during shock delivery, is another technique with potential to reduce the duration of the perishock pause (20,21). Although many models have shown the safety and efficacy of this practice, some studies raise concerns about electrical leak and the potential for harm to clinicians wearing commonly used nitrile examination gloves (22–24). Although hands-on defibrillation has potential to reduce perishock pauses and increase chest compression fraction, it is not universally recommended.

TFCPR and Prehospital Success

The above evidence-based principles have revolutionized our approach to CPR, and in recent years new prehospital cardiac arrest protocols have surfaced among local, regional, and state emergency medical services (EMS) agencies to further improve cardiac arrest care even beyond the current AHA advanced cardiovascular life support (ACLS) algorithms (25–27). Team-focused CPR (TFCPR), also known as high-performance CPR, or "pit crew" CPR, is one such protocol used by prehospital clinicians to streamline cardiac arrest resuscitation (27). TFCPR is a choreographed approach to CPR where