Editorial

Dispatcher-Directed Bystander Initiated Cardiopulmonary Resuscitation

A Safe Step, but Only a First Step, in an Integrated Approach to Improving Sudden Cardiac Arrest Survival

David G. Benditt, MD; MaryAnn Goldstein, MD; Richard Sutton, DSc; Demetris Yannopoulos, MD

Approximately 330 000 out-of-hospital cardiac arrests (OHCAs) occur annually in the United States; in essence, there are nearly 1000 OHCA events each day.[1] However, despite the presence of extensive emergency medical response systems (especially in heavily populated regions) and aggressive steps by both professional organizations and private industry to enhance public awareness of the magnitude of the problem and the need for cardiopulmonary resuscitation (CPR) training,[1,2] overall OHCA survival rates generally remain dismal and highly variable from location to location. On average, only ≈5% of OHCA victims leave the hospital.[3–6]

Article see p 91

Improving OHCA survival should be a healthcare priority, but effecting substantial improvement is complex. Experience suggests that altering current outcomes requires a well-organized, multifaceted treatment strategy. It is unlikely that introduction of any single intervention, no matter how novel, will do the trick. In fact, as the course of events that followed the introduction of portable automatic external defibrillators (AEDs) illustrates, excessive reliance on any single innovative technology might be detrimental. In that case, AED availability was initially accompanied by a seemingly paradoxical decline in resuscitation success.[7] Only later did it become evident that failure to initiate basic CPR while waiting for an AED to arrive undermined patient viability. Thus, although early defibrillation is now advocated if available quickly after a witnessed OHCA event, in most cases, CPR should be initiated first to "prime" the pump with oxygenated blood and increase the chances for a successful defibrillation.[1,2,7]

Importance of Bystander CPR

That prompt initiation of CPR in OHCA victims has a positive impact on survival is well established. In one of the earliest reports to emphasize the value of early CPR, Cummins et al[8] examined survival outcomes in 1297 OHCA events; 579 cases received bystander CPR, whereas CPR was delayed until paramedics arrived in 718 cases. The initiation of CPR was estimated to have occurred ≈3 minutes earlier in the bystander-initiated CPR group, and survival was ≈30% greater. Subsequently, Swor et al[9] examined resuscitation outcomes in 722 OHCA victims from Oakland County, Michigan, between July 1989 and July 1993; victims receiving bystander CPR had an 18% hospital discharge rate compared with 8% for those not receiving bystander CPR. A similar bystander CPR benefit was observed by Rea et al[10] in an early (1983 through 2000) but much larger experience from King County, Washington; in this case, however, the potential benefit of dispatcher-directed bystander CPR was highlighted. In dispatcher-directed CPR, the same operator (eg, 9–1-1 operator) who receives the emergency call from witnesses to a presumed OHCA event not only initiates dispatch of professional rescuers (eg, fire and/or police and emergency medical services) but also is trained to remain on the telephone and verbally assist bystanders with initiation of early CPR. The dispatcher may, for example, ask the bystander to place a mobile telephone near the victim. The telephone may be used by the dispatcher to assess the likelihood that the victim has truly suffered an OHCA (eg, evaluating victim's respirations) and, even more importantly, to instruct bystanders on basic CPR methodology and thereby help to optimize early intervention before the arrival of professional rescuers.

The initial King County dispatcher-directed experience reported by Rea et al[10] encompassed 7265 adult OHCA events and, as with the preceding reports,[8,9] spanned an era antedating full deployment of AEDs. Findings compared dispatcher-directed bystander CPR with both non–dispatcher-directed CPR and no bystander CPR. The frequency of bystander CPR was 26% and 30% for dispatcher-directed and non–dispatcher-directed CPR, respectively; compared with the no bystander CPR cohort, there was, by multivariate analysis, a clear survival improvement when CPR was initiated by bystanders. Overall survival to hospital discharge was 15%. Compared with no bystander CPR, the odds ratios for survival were 1.45 (95% confidence interval, 1.21 to 1.73) and 1.69 (95% confidence interval, 1.42 to 2.01) for dispatcher-directed and non–dispatcher-directed bystander CPR, respectively.[10]

Findings of the Ontario Prehospital Advanced Life Support (OPALS) study[3,11,12] provide additional evidence supporting

The opinions expressed in this article are not necessarily those of the editors or of the American Heart Association.

From the Cardiac Arrhythmia Center, Cardiovascular Division, Department of Medicine, University of Minnesota Medical School, Minneapolis (D.G.B., M.A.G., D.Y.), and St Mary's Hospital, Imperial College London, London, UK (R.S.).

Correspondence to David G. Benditt, MD, Cardiovascular Division, University of Minnesota Medical Center, Mail Code 508, 420 Delaware St SE, Minneapolis, MN 55455. E-mail bendi001@umn.edu

(*Circulation*. 2010;121:10-13.)

***Circulation* is available at http://circ.ahajournals.org**
DOI: 10.1161/CIR.0b013e3181cd3c9f

Table 1. Impact of Bystander CPR on Sustaining a Shockable Cardiac Rhythm in Witnessed OHCAs

VT/VF (ALS Response Time)		VT/VF (ALS Response time)	
Study	Bystander CPR, % (min)	No Bystander CPR, % (min)	*P**
Herlitz et al[15]	69 (8)	51 (9)	<0.001
Swor et al[9]	81 (8.6)	61 (7.5)	<0.01
Herlitz et al[16]	38-44† (6)	28 (8)	<0.001
KANTO-SOS[4]	29 (10)	19 (10)	<0.001
Shiraki et al[14]	19 (NA)	7 (NA)	(NA)

ALS indicates advanced life support.

Percent of patients in VT/VF at time (in parentheses) of ALS response team arrival from various studies for bystander CPR versus no bystander CPR.

*Comparison of bystander and no bystander VT/VF.

†Lay bystanders versus medical professional bystanders.

the value of bystander CPR. In 2003, Stiell et al[11] summarized the course of 8091 OHCA victims, of whom 418 (5.2%) survived to hospital discharge and 268 could be assessed in terms of health-related quality of life status after 1 year of follow-up. Findings revealed that younger age and male gender were associated with better functional outcomes but that the only modifiable factor leading to best quality of life at follow-up was "citizen-initiated CPR" (42% had bystander CPR in the better-functioning group versus 28% in the lower-functioning survivors). In a subsequent report from the OPALS study, Stiell and colleagues[12] noted an almost 4-fold greater survival rate for OHCA victims receiving bystander CPR than those who had not. Unfortunately, bystander CPR was initiated in only ≈15% of events, and overall survival to hospital discharge still remained low at ≈5%.

More recently, Markel et al,[13] in a retrospective analysis from King County, Washington, assessed outcomes in 1781 patients who received basic life support and advanced life support during the time frame of January 1991 through December 2007. A key finding from this study was that the likelihood of survival was substantially improved when bystander CPR was performed (odds ratio, 1.34; 95% confidence interval, 1.07 to 1.68).

Apart from potentially diminishing the severity of cerebral and cardiac ischemic injury, bystander CPR appears to prolong the period during which "shockable" rhythms (ie, ventricular fibrillation [VF] or ventricular tachycardia [VT]) are sustained during an OHCA event and delays cardiac rhythm degeneration to asystole, agonal rhythm, or electromechanical dissociation.[4,9,14–16] This beneficial effect would be expected to improve the likelihood of successful later defibrillation and translate into greater survival. In this regard, although raw numbers vary, a review of several reports reveals that compared with the absence of bystander CPR, the delivery of bystander CPR is associated with an ≈1.5-fold greater likelihood of VT or VF being present when advanced life support teams arrive (Table 1).

Current Bystander CPR Rates

Despite a proven positive impact on OHCA treatment, bystander CPR remains underused.[17] At best, as reported from King County, Washington,[10] and in surveys of witnessed OHCA events in Sweden, about one-half of OHCA events receive bystander CPR.[5,6] On the brighter side, however, the Swedish reports note that bystander CPR increased in frequency from ≈30% to 36% in the early 1990s to ≈50% in 2005 (55% for witnessed and 44% for unwitnessed OHCA), with a corresponding improvement in OHCA survival. Consequently, public education can have a positive impact on citizen-initiated CPR intervention. However, for the present, in most locales, it is estimated that bystander CPR is provided in only one fifth to one third of witnessed OHCA events.[2]

The reasons for relatively low bystander CPR intervention rates are multiple but include uncertainty about what to do, fear of communicable disease, possible cultural factors, and concern about harming the victim. The "what to do" and communicable disease concerns are to a large extent addressed by the guideline recommendation favoring chest compression–only bystander CPR.[2] The absence of rescuer-delivered ventilations for short periods of time does not appear to adversely affect survival. Consequently, it is now recommended that a citizen bystander perform compression-only CPR after he/she has called 9–1-1 and until the paramedics or a defibrillator arrive.[2] Cultural inhibition to undertaking CPR[14,18,19] is difficult to address, and making inroads into this problem requires a considerable long-term education effort and persistent encouragement of an apparently reluctant population. The worry that the OHCA victim might be injured during bystander CPR is a subject amenable to scientific inquiry and is, in fact, the focus of the report by White et al[20] in this issue of *Circulation*.

White et al[20] examined the impact on noncardiac arrest victims of dispatcher-directed bystander CPR. The investigators report that among 1700 dispatcher-directed CPR events, in only 18% was the victim ultimately found not to be in cardiac arrest (mainly cases ultimately diagnosed as intoxication, seizure, or syncope). There were no deaths attributed to bystander CPR, and in only 2% of cases was an injury clearly attributed to the CPR, whereas injury may have been related to CPR in another 3%. A further 12% complained of some discomfort that may have been CPR related. Overall, given the demonstrable benefit of early initiation of CPR in OHCA events, the risk to victims of bystander intervention seems low and justified by the potential survival benefits. On the other hand, this report from King County must be considered a best-case scenario. It most likely reflects what should be obtainable among the most experienced emergency medical response systems in the United States. Less experienced emergency response systems will inevitably exhibit a learning curve, with higher misdiagnosis rates and likely higher injury risk rates. Nevertheless, the risks seem low and a reasonable price to pay given that critical time is wasted and lives are lost if CPR is delayed.

Conclusions

Maximizing OHCA survival is a complex process. Current experience suggests that a multifaceted systematic approach to the treatment of OHCA victims offers the best chance of substantially improving survival statistics (Table 2).[1,21,22] Success demands that the strategy begin immediately at the

Table 2. Potential Enhancement of OHCA Survival by Systematic Application of Multiple Resuscitation Interventions

Intervention	Effect	Estimate of Increased Absolute Survival Rate, %
Bystander CPR	Rapid EMS notification	2-5
	Early circulation assist	
	Improved viability for later ALS	
	Greater likelihood of sustaining VT or VF improves later defibrillation success	
Widespread AED deployment	Reduced time to first shock in VT/VF patients	4-6
Improved CPR quality and drug delivery	Increased circulation to heart and brain	6-10
Prevent hyperventilation	Increased O_2 and drug delivery	
Continuous chest compressions		
CPR before/after shock		
Intraosseous drug delivery		
Automated AC-DC devices		
Impedance threshold device		
Resuscitation centers	Enhanced neurological care	5-10
Standard hypothermia protocols	Improved metabolic/ventilation support	
Intensive ventilation, hemodynamic care units	Organ preservation	
	Coronary revascularization	

ALS indicates advanced life support; AC/DC, active compression-decompression. Potential survival enhancement: 20% to 30%.

site of the event with encouragement of early CPR initiation for suspected sudden cardiac arrest whether on the street, in the workplace, or in the home. It is essential that bystander CPR rates increase; it is early CPR that in most instances sets the stage for successful OHCA resuscitation.

Aggressive public education efforts emphasizing recommendations for simplified (chest compression only) CPR techniques and fostering dispatcher-directed CPR may help to improve the frequency with which bystanders initiate CPR. In this regard, broad-based educational initiatives highlighting the importance of bystander CPR and the roles of chest compression-only CPR and AEDs led by both the American Heart Association and regional organizations (eg, Take Heart America®) are ongoing. The next step, widespread availability of dispatcher-directed CPR, is now in need of being more broadly implemented and advertised. As pointed out by White et al,[20] dispatcher-directed CPR can be safe. Beyond that, however, availability of dispatcher-directed CPR will provide encouragement for greater citizen-initiated CPR; the bystander will feel less alone and more competent.

Early effective bystander CPR offers the opportunity to buy critical time needed for professional rescuers to arrive with the expertise to provide defibrillator shocks as appropriate[1]; ventilation support following current guideline recommendations (including application of respiratory impedance threshold devices to enhance systemic circulation during resuscitation)[1]; active compression-decompression CPR (in particular, automated externally powered active compression-decompression machines to replace fatiguing rescuers); drug therapies, including intraosseous access if needed[1]; cooling protocols (whether at the OHCA site or in the hospital); and rapid transport to a hospital experienced in subsequent care of resuscitated OCHA victims. The ultimate goal should be universal deployment of a systematic approach to OHCA resuscitation with target survival rates closer to 50% rather than the current 5%.

Disclosures

Dr Benditt has served as a consultant for and holds equity in Medtronic Inc and Transoma Inc and holds equity in and is a member of the Board of Directors for Advanced Circulatory Systems Inc. Dr Goldstein holds equity in Medtronic Inc, Transoma Inc, and Advanced Circulatory Systems Inc. Dr Sutton has served as a consultant for Medtronic Inc. and holds equity in Advanced Circulatory Systems Inc. Dr Yannopoulos reports no conflict.

References

1. 2005 American Heart Association guidelines for cardiopulmonary resuscitation and emergency cardiovascular care. *Circulation.* 2005; 112(suppl): IV-1– IV-203.
2. Sayre MR, Berg RA, Cave DM, Page RL, Potts J, White RD. Hands-only (compression only) cardiopulmonary resuscitation: a call to action for bystander response to adults who experience out-of-hospital sudden cardiac arrest. *Circulation*. 2008;117:2162–2167.
3. Stiell I, Wells GA, Maio VJ, Spaite DW, Field BJ III, Munkley DP, Lyver MB, Luinstra LG, Ward R. Modifiable factors associated with improved cardiac arrest survival in a multicenter basic life support/defibrillation system. *Ann Emerg Med*. 1999;33:44–50.
4. SOS-KANTO Study Group. Cardiopulmonary resuscitation by bystanders with chest compression only (SOS-KANTO): an observational study. *Lancet.* 2007;369:920–926.
5. Hollenberg J, Herlitz J, Lindqvist J, Riva G, Bohm K, Rosenqvist M, Svensson L. Improved survival after out-of-hospital cardiac arrest is associated with increase in proportion of emergency-crew witnessed and bystander cardiopulmonary resuscitation. *Circulation*. 2008;118: 388–396.
6. Nordberg P, Hollenberg J, Herliz J, Rosenqvist M, Svensson L. Aspects on the increase of bystander CPR in Sweden and its association with outcome. *Resuscitation*. 2009;80:329–333.
7. Cobb LA, Fahrenbruch CE, Walsh TR, Copass MK, Olsufka M, Breskin M, Hallstrom AP. Influence of cardiopulmonary resuscitation prior to defibrillation in patients with out-of-hospital ventricular fibrillation. *JAMA*. 1999;281:1182–1188.
8. Cummins RO, Eisenberg MS, Hallstrom AP, Litwin PE. Survival of out-of-hospital cardiac arrest with early initiation of cardiopulmonary resuscitation. *Am J Emerg Med*. 1985;3:114–119.
9. Swor RA, Jackson R, Cynar M, Sadler E, Basse E, Boji B, Rivera-Rivera EJ, Maher A, Grubb W, Jacobson R, Dalbec DL. Bystander CPR, ventricular fibrillation, and survival in witnessed, unmonitored out-of-hospital cardiac arrest. *Ann Emerg Med*. 1995;25:780–784.
10. Rea TD, Eisenberg MS, Culley LL, Becker L. Dispatcher-assisted cardiopulmonary resuscitation and survival in cardiac arrest. *Circulation*. 2001;104:2513–2516.
11. Stiell I, Nichol G, Wells G, De Maio V, Nesbitt L, Blackburn J, Spaite D, for the OPALS Study Group. Health-related quality of life is better for

cardiac arrest survivors who received citizen cardiopulmonary resuscitation. *Circulation.* 2003;108:1939–1944.
12. Stiell IG, Wells G, Field B, Spaite DW, Nesbitt LP, De Maio VJ, Nichol G, Cousineau D, Blackburn J, Munkley D, Linstra-Toohey L, Campeau T, Dagnone E, Lyver M, for the Ontario Pre-Hospital Advanced Life Support Study Group. Advanced cardiac life support in out-of-hospital cardiac arrest. *N Engl J Med.* 2004;351:641–656.
13. Markel DT, Gold LS, Fahrenbruch CE, Eisenberg MS. Prompt advanced life support improves survival from ventricular fibrillation. *Prehosp Emerg Care*. 2009;13:329–334.
14. Shiraki T, Osawa K, Suzuki H, Yoshida M, Takahashi N, Takeuchi K, Tanakaya M, Kohno K, Saito D. Incidence and outcomes of out-of-hospital cardiac arrest in the eastern part of Yamaguchi prefecture. *Int Heart J*. 2009;50:489–500.
15. Herlitz J, Ekstrom L, Wennerblom B, Axelsson A, Bang A, Holmberg S. Effect of bystander initiated cardiopulmonary resuscitation on ventricular fibrillation and survival after witnessed cardiac arrest outside hospital. *Br Heart J*. 1994;72:408–412.
16. Herlitz J, Svensson L, Holmberg S, Angquist A, Young M. Efficacy of bystander CPR: intervention by lay people and by health care professionals. *Resuscitation*. 2005;66:291–295.
17. Vaillancourt C, Stiell IG, Wells GA. Understanding an improving low bystander CPR rates: a systematic review of the literature. *Can J Emerg Med*. 2008;10:51–65.
18. Vadeboncoeur TF, Richman PB, Darkoh M, Chikani V, Clark L, Bobrow BJ. Bystander cardiopulmonary resuscitation for out-of-hospital cardiac arrest in the Hispanic vs non-Hispanic populations. *Am J Emerg Med*. 2008;26:655–660.
19. Kuramoto N, Morimoto T, Kubota Y, Maeda Y, Seki S, Takada K, Hiraide A. Public perception of and willingness to perform bystander CPR in Japan. *Resuscitation.* 2008;79:475–481.
20. White L, Rogers J, Bloomingdale M, Fahrenbruch C, Culley L, Subido C, Eisenberg M, Rea T. Dispatcher assisted cardiopulmonary resuscitation: risks for patients not in cardiac arrest. *Circulation.* 2010;121:91–97.
21. Yannopoulos D, Aufderheide T. Acute management of sudden cardiac death in adults based upon the new CPR guidelines. *Europace*. 2007; 9:2–9.
22. Lurie KG, Idris A, Holcomb JB. Level 1 cardiac arrest centers: learning from the trauma surgeons. *Acad Emerg Med*. 2005;12:79–80.

KEY WORDS: Editorials ■ cardiac arrest ■ cardiopulmonary resuscitation ■ death sudden ■ ventricular fibrillation

Dispatcher-Directed Bystander Initiated Cardiopulmonary Resuscitation: A Safe Step, but Only a First Step, in an Integrated Approach to Improving Sudden Cardiac Arrest Survival

David G. Benditt, MaryAnn Goldstein, Richard Sutton and Demetris Yannopoulos

Circulation. 2010;121:10-13; originally published online December 21, 2009;
doi: 10.1161/CIR.0b013e3181cd3c9f
Circulation is published by the American Heart Association, 7272 Greenville Avenue, Dallas, TX 75231

Print ISSN: 0009-7322. Online ISSN: 1524-4539