Dispatcher-Assisted Cardiopulmonary Resuscitation

Risks for Patients Not in Cardiac Arrest

Lindsay White, MPH; Joseph Rogers, MS; Megan Bloomingdale; Carol Fahrenbruch, MSPH; Linda Culley, BA; Cleo Subido, RPL; Mickey Eisenberg, MD, PhD; Thomas Rea, MD, MPH

Background**—**Dispatcher-assisted cardiopulmonary resuscitation (CPR) instructions can increase bystander CPR and thereby increase the rate of survival from cardiac arrest. The risk of bystander CPR for patients not in arrest is uncertain and has implications for how assertive dispatch is in instructing CPR. We determined the frequency of dispatcher-assisted CPR for patients not in arrest and the frequency and severity of injury related to chest compressions.

Methods and Results**—**The investigation was a prospective cohort study of adult patients not in cardiac arrest for whom dispatchers provided CPR instructions in King County, Washington, between June 1, 2004, and January 31, 2007. The study focused on those who received chest compressions. Information was collected through review of the audio and written dispatch report, written emergency medical services report, hospital record, and telephone survey. Of the 1700 patients for whom dispatcher CPR instructions were initiated, 55% (938 of 1700) were in arrest, 45% (762 of 1700) were not in arrest, and 18% (313 of 1700) were not in arrest and received bystander chest compressions. Of the 247 not in arrest who received chest compressions and had complete outcome ascertainment, 12% (29 of 247) experienced discomfort, and 2% (6 of 247) sustained injuries likely or possibly caused by bystander CPR. Only 2% (5 of 247) suffered a fracture, and no patients suffered visceral organ injury.

Conclusions**—**In this prospective study, the frequency of serious injury related to dispatcher-assisted bystander CPR among nonarrest patients was low. When coupled with the established benefits of bystander CPR among those with arrest, these results support an assertive program of dispatcher-assisted CPR. **(*Circulation*. 2010;121:91-97.)**

Key Words: cardiopulmonary resuscitation ■ complications ■ dispatcher ■ epidemiology ■ morbidity

Rapid initiation of cardiopulmonary resuscitation (CPR) can increase the chance of survival from cardiac arrest.[1,2] Nevertheless, in many communities, fewer than a quarter of cardiac arrest victims receive bystander CPR before emergency medical services (EMS) arrival, which indicates an opportunity to improve the survival rate if bystanders initiated CPR more frequently.[3,4] CPR instructions provided over the telephone by the 9-1-1 emergency dispatcher, called dispatcher-assisted CPR, can substantially increase bystander-initiated CPR and thereby increase the chance for survival from out-of-hospital cardiac arrest.[5]

Editorial see p 10
Clinical Perspective on p 97

Identification of cardiac arrest by dispatchers and bystanders can sometimes be challenging.[6,7] A number of conditions, including syncope, seizure, hypoglycemia, overdose, and cerebrovascular accident, can resemble cardiac arrest.[8] As a consequence, patients who are not in cardiac arrest can receive CPR. Indeed, strict compliance with common dispatch protocols for arrest identification would more often result in CPR for patients not in cardiac arrest than for the true arrest patient.[9] Although CPR can be lifesaving in cardiac arrest, CPR and particularly chest compressions can cause serious injury, including rib and sternal fractures, internal organ lacerations, and pulmonary complications.[10,11] For the patient not in arrest, CPR typically offers no benefit and the potential of risk. Thus, dispatchers may hesitate or be reluctant to invoke CPR instructions, given the uncertainty of the cardiac arrest diagnosis and the potential risk of CPR-provoked injury. A better understanding of the risk of bystander CPR in patients not in arrest can influence the dispatcher's approach. If the risk of injury is substantial, then dispatchers may exercise caution in offering and implementing instruction. Conversely, if risk in these patients without arrest is modest, dispatchers should be assertive in their efforts to initiate CPR. The purposes of this investigation are to determine the frequency of dispatcher-assisted bystander CPR for patients not in cardiac arrest and to determine the

Received April 9, 2009; accepted September 21, 2009.
From Public Health Seattle–King County, Emergency Medical Services Division (L.W., M.B., C.F., L.C., C.S., M.E., T.R.), and the University of Washington, Department of Medicine (J.R., M.B., M.E., T.R.), Seattle.
The online-only Data Supplement is available with this article at http://circ.ahajournals.org/cgi/content/full/CIRCULATIONAHA.109.872366/DC1.
Correspondence to Lindsay White, MPH, Emergency Medical Services Division, Public Health Seattle-King County, 401 Fifth Ave, Suite 1200, Seattle, WA 98104. E-mail lindsay.white@kingcounty.gov

Circulation **is available at http://circ.ahajournals.org** **DOI: 10.1161/CIRCULATIONAHA.109.872366**

frequency and severity of injury related to chest compressions for these patients.

Methods

Study Design, Population, and Setting

The investigation was a prospective cohort study of patients for whom the emergency dispatcher accessed CPR instructions to provide dispatcher-assisted telephone CPR instructions in King County, Washington (excluding Seattle), between June 1, 2004, and January 31, 2007. The present study focused on the subset of subjects who were not in cardiac arrest and specifically the group for whom bystander CPR progressed to chest compressions. We focused on the latter group because chest compressions are the component of CPR believed most likely to cause injury.

Eligible subjects were identified through the Dispatcher Assisted Resuscitation Trial (DART), an ongoing randomized clinical trial of dispatcher-assisted CPR instructions comparing chest compressions alone with chest compressions plus ventilations for out-of-hospital cardiac arrest (www.clinicaltrials.gov, NCT00219687). A case is eligible for DART if the emergency dispatcher determines that a patient is unconscious and not breathing normally and that bystander CPR is not ongoing. On determination of eligibility, dispatchers open an envelope that randomly assigns the case to CPR with chest compressions alone or chest compressions plus ventilations. Exclusion criteria for DART include patient age $<$ 18 years, cardiac arrest resulting from a traumatic or mechanical respiratory mechanism (ie, choking, strangulation, suffocation), and do-not-attempt-resuscitation orders. The DART study was conducted under a waiver of consent. King County (excluding Seattle) has a population of $\approx$1.2 million persons according to the 2000 US Census and includes urban, suburban, and rural areas. Study methods were approved by the pertinent institutional review boards.

Dispatcher-Assisted CPR

Emergency dispatchers in King County follow a standard approach to identify a potential cardiac arrest patient.[12] After obtaining information about the location (address) and age of the patient, the dispatcher asks the caller if the patient is conscious. If the answer is no, then the dispatcher asks if the patient is breathing normally. If the answer to this question is also no, the patient is presumed to be in cardiac arrest. If the caller is uncertain whether the patient is breathing normally, the dispatcher asks if the patient's chest is rising and falling in a normal pattern. The dispatcher may also ask the caller to describe the breathing or ask the caller to place the phone next to the patient so that the dispatcher can listen to the patient. Dispatchers are trained to listen for any indication of gasping, snoring, gurgling, moaning, noisy breathing, or intermittent breathing. If the caller uses these words to describe the patient's breathing or if the dispatcher is able to hear this abnormal breathing over the telephone, the patient is presumed to be in cardiac arrest. The dispatcher inquires whether someone on scene knows CPR and has started CPR. Dispatchers are trained to provide CPR instruction to bystanders when a cardiac arrest patient is not receiving CPR before EMS arrival. Each case is dynamic, but whenever possible, the dispatcher has the bystander place the phone near the patient or has a second bystander remain on the line. The bystander performs a cycle of CPR during which the dispatcher asks the bystander to count the chest compressions out loud. After the first cycle, the dispatcher can inquire about the patient (signs of life) or encourage the bystander to continue if the patient remains unconscious and without normal breathing. Dispatchers stay on the phone line until EMS arrives at the scene.

EMS System

The area is served by a 2-tiered EMS system that is activated by calling 9-1-1 and speaking with an emergency dispatcher. The first tier consists of firefighter–emergency medical technicians who are trained in basic life support and the use of automated external defibrillators. The second tier consists of paramedics who are trained in advanced life support. Both tiers are dispatched simultaneously in the case of a suspected cardiac arrest. In King County, the average time from call receipt to unit dispatch is 40 seconds. First-tier EMS providers arrive on scene an average of 5 minutes after call receipt. The second tier arrives on average 5 minutes after the first tier.

Data Collection and Definitions

Study information was collected through review of the audio and written dispatch report, the written EMS report, and, when available, the hospital record and a telephone survey. Subjects were classified as having had a cardiac arrest if the EMS documented absence of a pulse on evaluation or if the subject had received a public-access defibrillator shock before EMS arrival. Patients not in cardiac arrest had a pulse (without public-access defibrillation) on EMS arrival. Performance of bystander chest compression was determined through review of the audio dispatch recording.

To determine the duration of bystander CPR in patients who were not in cardiac arrest but received chest compressions, we performed a secondary review of the dispatch recordings in a random 20% sample of cases. We defined the initiation of CPR as the time of the first ventilation (for those receiving chest compressions plus ventilations) or chest compression (for those receiving chest compressions alone). Bystander CPR was stopped either before EMS arrival or by EMS personnel on their arrival. These times were determined from either the dispatch recording or EMS run report.

To determine clinical and CPR outcomes for patients not in cardiac arrest who received bystander chest compressions, we reviewed hospital records and conducted a telephone survey. Hospital record review included assessment of radiology reports; emergency, admission, and discharge notes; and procedure and operative reports. The intent of the abstraction was to determine whether the patient suffered injuries as a result of CPR and whether these injuries required additional care. The abstraction form inquired about rib and sternal fractures and internal organ injury of the chest or abdominal cavities. Injuries were classified as probably or possibly caused by CPR. Injuries were classified as possibly caused by CPR when it was unclear that there was discomfort or an injury or when the discomfort and injuries could not be directly attributed to the bystander CPR. Examples include pain present before the 9-1-1 call, trauma occurring when the patient collapsed, or trauma occurring during EMS care. We also made 3 separate attempts to contact this group of patients by phone whenever possible. Using a formal interview form, we inquired whether the subject suffered injuries resulting from CPR and, if yes, whether the subject had in turn required specific treatment, including hospitalization for the injuries.

Data Analysis

We used descriptive statistics to examine the frequency, characteristics, and CPR outcomes of patients not in cardiac arrest. Using χ^2 for categorical variables or the independent-sample t test for continuous variables, we compared characteristics and CPR outcomes between patients who progressed to chest compressions and those who received only ventilations or no CPR and between those randomized to chest compressions alone and those randomized to chest compressions plus ventilations. The Fisher exact test was used in cases in which the expected number of observations was $<$5. Statistical analyses were completed with SPSS version 14.0 (SPSS Inc, Chicago, Ill).

The authors had full access to the data and take full responsibility for the integrity of the data. All authors have read and agree to the manuscript as written.

Results

Between June 1, 2004, and January 31, 2007, emergency dispatchers offered telephone CPR instructions for 1700 patients (Figure). Fifty-five percent (938 of 1700) of patients were in cardiac arrest on EMS arrival, with 774 receiving resuscitation efforts by EMS personnel. Forty-five percent (762 of 1700) were not in cardiac arrest. Of the patients not

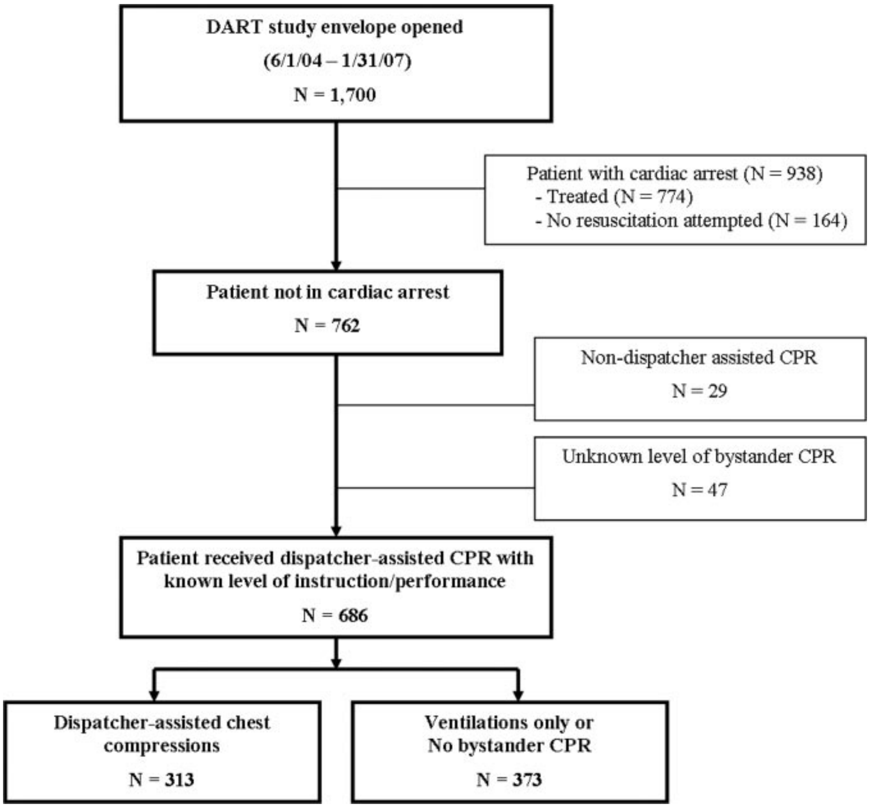

Figure. Flow diagram of subject eligibility.

in arrest with a known level of CPR performance, 46% (313 of 686) received chest compressions from a bystander as a consequence of dispatcher assistance. Overall, 18% (313 of 1700) of dispatcher-assisted CPR instruction resulted in bystander chest compressions for patients not in cardiac arrest.

Table 1 presents the characteristics of patients not in arrest who received dispatcher-assisted CPR stratified by chest

Table 1. Characteristics of Patients Not in Cardiac Arrest, Overall and According to Chest Compression Status

	All Patients Not in Cardiac Arrest (n=686)	Chest Compressions(n=313)	Ventilations Only or No Bystander CPR (n=373)	*P*
Age, mean±SD, y	56.8±22.4	53.9±22.0	59.2±22.6	0.002
Male sex, n (%)	367 (53.5)	175 (55.9)	192 (51.5)	0.35
EMS assessment, n (%)				<0.0001
Cerebrovascular event	78 (11.4)	42 (13.4)	36 (9.7)	
Hypoglycemia	62 (9.0)	35 (11.2)	27 (7.2)	
Overdose/intoxication	141 (20.6)	87 (27.8)	54 (14.5)	
Seizure	120 (17.5)	51 (16.3)	69 (18.5)	
Syncope	105 (15.3)	32 (10.2)	73 (19.6)	
Other illness*	180 (26.2)	66 (21.1)	114 (30.6)	
Transport, n (%)				<0.0001
Advanced life support	310 (45.2)	167 (53.4)	143 (38.3)	
Basic life support	275 (40.1)	114 (36.4)	161 (43.2)	
Private vehicle	4 (0.6)	1 (0.3)	3 (0.8)	
No transport	97 (14.1)	31 (9.9)	66 (17.7)	
Randomization, n (%)				<0.0001
Chest compressions alone	340 (49.6)	194 (62.0)	146 (39.1)	
Compressions plus ventilations	346 (50.4)	119 (38.0)	227 (60.9)	

*The other illness category comprised mostly respiratory conditions, cardiovascular emergencies, and psychiatric issues.

Table 2. Outcomes of Patients Not in Cardiac Arrest Who Received Dispatcher-Assisted Bystander Chest Compressions, Overall and According to Randomization Assignment

	Overall (n=247)	Compressions Alone (n=152)	Compressions Plus Ventilations (n=95)	P
Hospital admission status, n (%)				0.31
Admitted	157 (63.6)	97 (63.8)	60 (63.2)	
Treated in emergency department and released	83 (33.6)	50 (32.9)	33 (34.7)	
Died in emergency department	3 (1.2)	1 (0.7)	2 (2.1)	
Left emergency department against medical advice	4 (1.6)	4 (2.6)	0 (0.0)	
Discharge disposition (n=157), n (%)				0.89
Discharged alive	125 (79.6)	76 (78.3)	49 (81.7)	
Died in hospital	17 (10.8)	12 (12.4)	5 (8.3)	
Transferred, disposition unknown	15 (9.6)	9 (9.3)	6 (10.0)	
Chest imaging performed, n (%)				0.71
Yes	166 (67.2)	101 (66.4)	65 (68.4)	
No	81 (32.8)	51 (33.6)	30 (31.6)	
Any CPR pain or injury, n (%)				0.92
Yes	22 (8.9)	14 (9.2)	8 (8.4)	
Possible	9 (3.6)	6 (3.9)	3 (3.2)	
No	216 (87.4)	132 (86.8)	84 (88.4)	
Injury type, n (%)				
Pain				0.71
Yes	22 (8.9)	14 (9.2)	8 (8.4)	
Possible	7 (2.8)	4 (2.6)	3 (3.2)	
Rib fractures				0.46
Yes	2 (0.8)	2 (1.3)	0 (0.0)	
Possible	2 (0.8)	2 (1.3)	0 (0.0)	
Internal bleeding				0.71
Yes	0 (0.0)	0 (0.0)	0 (0.0)	
Possible	1 (0.4)	1 (0.7)	0 (0.0)	
Other injuries				0.71
Yes	1 (0.4)	1 (0.7)	0 (0.0)	
Possible	0 (0.0)	0 (0.0)	0 (0.0)	

compression status. Overall, the average age was 57 years; just over half were male. The most common condition as assessed by EMS was a drug or alcohol overdose (21%), followed by seizure (18%), syncope (15%), cerebrovascular event (11%), and hypoglycemia (9%). Those who received chest compressions were more likely to have experienced an overdose and less likely to have had a syncopal episode or other illness than those who did not progress to chest compressions ($P<0.0001$). The large majority were transported to the hospital by EMS (85%), most commonly by paramedics. Overall, half of the patients not in cardiac arrest were randomized to chest compression alone, and half were randomized to chest compression plus ventilations. However, a larger proportion of patients who received chest compressions were randomized to the chest compressions–only arm ($P<0.0001$). When stratified by randomization status, 57.1% (194 of 340) of chest compression–only CPR instruction compared with 34.4% (119 of 346) of chest compression plus ventilation instruction resulted in bystander chest compressions for the patient not in cardiac arrest. The median duration of bystander CPR for patients who progressed to chest compressions, as determined from our review of a random 20% sample of cases, was 91 seconds, with a minimum duration of 1 second and a maximum duration of 405 seconds (interquartile range, 44 to 189 seconds).

Hospital chart reviews were completed for 247 of the 281 patients (88%) who received dispatcher-assisted chest compressions and were subsequently transported to the hospital. We were unable to review 34 hospital charts because the prehospital data could not be directly matched with the hospital record. Analyses indicated that the EMS diagnostic profiles, transport level, and Glasgow coma scores at the end of EMS care were comparable between the patients with and without an available hospital chart. Overall, one third of the patients transported were treated in the emergency department and released; two thirds were admitted to the hospital (Table 2). There were no significant differences in hospital admission status or discharge disposition according to randomization group ($P=0.31$ and $P=0.89$, respectively).

No deaths were attributed to bystander CPR. Of the 247 patients whose charts were reviewed, 22 (9%) experienced chest discomfort or pain as a probable consequence of dispatcher-assisted bystander CPR (Table I of the online-only Data Supplement). Four patients (2%) sustained injuries as a result of the bystander CPR: 1 patient had a clavicular fracture; 1 patient had confirmed rib fractures; another had suspected rib fractures; and 1 patient had a hip fracture caused by the bystander pulling the patient to the floor to begin CPR. There were no reports of sternal fracture, organ laceration, or other injuries. Another 3% (7 of 247) experienced chest discomfort or pain, and 1% (2 of 247) suffered injuries that were a possible consequence of bystander CPR (Table II of the online-only Data Supplement). Of the 2 injured patients, 1 had rib fractures, and 1 had tracheal bleeding possibly resulting from the CPR. Review of this case indicated that the tracheal bleeding was self-limited and required no additional intervention. No other injuries were noted for these 9 patients. Analyses suggested that the 31 patients who experienced pain or injuries as a likely or possible consequence of bystander CPR were similar in age, randomization status, and EMS diagnostic profiles to all other patients not in arrest who received chest compressions. However, injured patients were significantly more likely to be female than those not injured (68% and 41% female, respectively; $P=0.005$).

Telephone interviews were attempted with the 313 patients who received chest compressions from a bystander with dispatcher assistance. Seventy-three patients (23%) consented to participate, 8 (3%) refused, and 5 (2%) were unable to complete the interview because of a language barrier or an inability to recall the incident. For 157 patients (50%), we had no functioning contact information, and we were unable to contact the remaining 70 patients (22%) despite multiple attempts. There were no statistical differences between those interviewed and those not interviewed according to randomization group (chest compression only, 60% versus 63%), EMS diagnostic profiles (eg, seizure, 19% versus 15%), transport level (advanced life support, 63% versus 50%), and patient outcomes (death, 6% versus 7%). Those completing the interview were significantly older than those not interviewed (60.4 versus 52.0 years of age; $P=0.004$). Of the 73 patients who completed the interview, 14 (19%) reported discomfort or injuries resulting from the bystander CPR. All 14 stated that they experienced soreness in their chest. In addition, 2 reported rib fractures, and 1 reported lower back pain. There were no reports of lacerated organs, internal bleeding, or other complications. Of the patients reporting injuries, 3 required treatment, including pain medication, breathing treatments, or physical therapy. No patients required hospitalization for their injuries.

Discussion

In this cohort study of dispatcher-assisted bystander CPR, nearly half of the patients for whom emergency dispatchers offered CPR instructions were not in cardiac arrest. Approximately 18% of dispatcher-assisted CPR instruction resulted in bystander chest compressions for patients not in cardiac arrest. For these patients, EMS most often determined that the patient had a drug or alcohol overdose, seizure, syncope, cerebrovascular event, or hypoglycemia. A total of 9% of these patients experienced discomfort, and 2% sustained injuries likely attributed to the bystander CPR; an additional 3% possibly experienced discomfort, and 1% possibly suffered injuries resulting from bystander CPR. However, only 2% of patients not in arrest suffered a fracture, and no patients experienced visceral organ injury or death as a consequence of bystander CPR.

Ideally, emergency dispatchers would be able to identify each case of cardiac arrest comprehensively and precisely so that CPR instructions could be provided in a timely and directed manner. The goal is to apply simple questions that can quickly identify most true arrest patients while excluding patients without arrest, given the potential risk attributed to unnecessary CPR. The optimal balance between sensitivity and specificity depends in part on the operating characteristics of the identification questions and the risks associated with CPR for those not in arrest.

The 2-question approach used in the present study to identify potential cardiac arrest is straightforward and now commonly used in various dispatch protocols. With this approach, 18% of dispatcher CPR instruction resulted in chest compressions for patients not in arrest. Although exacting comparisons are difficult, this "false-positive" rate is comparable to prior reports from communities with well-integrated and established dispatch systems.[13,14] One consideration is to alter or add questions to limit the number of these false-positive cases. However, prior investigation indicates that some patients with cardiac arrest are not identified with the 2-question approach.[6,7,9,15] Moreover, additional efforts to decrease false-positive CPR would likely delay and further reduce the yield of true arrests. For example, the current question asks whether the patient is breathing normally. In several of the current false-positive conditions, breathing is present but abnormal. False-positives would likely be reduced if the question simply asked whether the patient was breathing, but then true arrest patients with agonal respirations would also be excluded. Patients with agonal respirations are potentially the most viable arrest patients, and early identification and bystander CPR may be especially important for resuscitation.[16]

A second consideration when determining the optimal balance of sensitivity and specificity is the risk associated with unnecessary bystander CPR, a risk not previously well investigated. Serious injuries such as rib fracture resulting from unnecessary bystander CPR were uncommon, occurring in 2% of patients who received bystander chest compressions. This rate of injury is far lower than what has been observed in previous studies of CPR complications, which have reported rates of injury ranging from 21% to 65%.[17,18] These prior studies, however, were primarily autopsy studies conducted on true cardiac arrest patients who had undergone extended resuscitation efforts by medical personnel. Longer duration of CPR is associated with an increased risk of injury.[10] In the present study, patients not in cardiac arrest received only a median duration of 91 seconds of (bystander) CPR. CPR was interrupted by the arrival of EMS or when characteristics indicating that the patient was not in arrest became apparent to the bystander or dispatcher. Moreover, simulation studies suggest that CPR by laypersons often does not produce guideline-directed compression depth and thus would presumably be less likely to cause injury.[19]

On the basis of evidence indicating at least comparable outcomes for chest compression alone compared with chest compression plus ventilation CPR, some but not all CPR guideline organizations advocate chest compression alone for presumed cardiac arrest with witnessed collapse in an effort to increase the proportion of patients receiving bystander CPR.[3] The present investigation is set within a randomized trial of dispatcher instruction comparing chest compression alone with chest compression plus ventilation, providing the opportunity to evaluate how instruction type would affect CPR among patients not in cardiac arrest. As might be anticipated, chest compressions were more frequently provided to patients randomized to chest compression only. Given the low observed rate of serious injury to these nonarrest patients regardless of the type of CPR instruction, the choice of CPR type (chest compression alone versus chest compression plus ventilation) should depend on which instruction type provides greater benefit to the true arrest patient rather than the potential risk to the patient not in arrest.

This study has limitations. We relied primarily on hospital record review supplemented by telephone survey to ascertain adverse events related to CPR. The study used hospital records available as part of regular clinical care and did not specifically mandate chest x-ray or other diagnostic evaluations that might be directed toward complete ascertainment of CPR injury. For this reason, the injuries identified in this study should be considered clinically apparent but may underestimate the extent and amount that might have been identified with a more comprehensive ascertainment protocol. Hospital charts could not be obtained for ≈10% of patients receiving chest compressions who were transported to the hospital and another 10% who did not receive hospital evaluation. The frequency of serious injury could differ in cases that could not be reviewed, although clinical characteristics based on review of the EMS record were similar between those with and without hospital information among those transported to hospital. We did not systematically evaluate patients who were not in arrest and did not receive chest compressions. Potential exists for injury before chest compression, as illustrated by the patient who suffered a hip fracture during initial positioning, but we believe the risk of injury is lower given the absence of any chest compressions. With this consideration in mind, the current program of dispatcher CPR instruction produced serious injury as defined by fracture or documented visceral injury in 0.3% of patients (5 of 1700) for whom dispatcher CPR was initiated. Conversely, dispatcher-assisted CPR enabled bystander CPR in ≈25% of cardiac arrest patients in the study community.[5] Finally, the results are derived from a heterogeneous community in which dispatchers have a mature experience with CPR instruction and are currently participating in a randomized trial of dispatcher-assisted CPR. Results may differ in other communities that use distinct protocols or have a different emphasis. The investigators regard the dispatchers of the study community as generally assertive and thus would not typically expect false-positive CPR instruction or CPR-induced injury to occur more frequently in most communities.

In this prospective cohort study, the patient was not in arrest in almost half of cases in which dispatcher-assisted CPR was initiated. Ultimately, 18% of dispatcher instruction resulted in chest compression for patients not in arrest. However, the frequency of serious injury in the nonarrest group was very low. Coupled with the established benefits of bystander CPR among those with arrest, these results support an assertive program of dispatcher-assisted CPR as a meaningful approach to improve survival from out-of-hospital cardiac arrest.

Acknowledgments

We acknowledge the emergency dispatchers, the EMTs, and the paramedics throughout King County for their ongoing efforts to improve care for persons suffering out-of-hospital cardiac arrest.

Sources of Funding

The study was supported in part by a grant from the Laerdal Foundation and the Medic One Foundation. These groups had no role in study design, conduct, or interpretation of the results.

Disclosures

None.

References

1. Cobb LA, Hallstrom AP. Community-based cardiopulmonary resuscitation: what have we learned? *Ann N Y Acad Sci*. 1982;382:330–342.
2. Stiell I, Nichol G, Wells G, De Maio V, Nesbitt L, Blackburn J, Spaite D. Health-related quality of life is better for cardiac arrest survivors who received citizen cardiopulmonary resuscitation. *Circulation*. 2003;108: 1939–1944.
3. 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: a science advisory for the public from the American Heart Association Emergency Cardiovascular Care Committee. *Circulation*. 2008;117:2162–2167.
4. 2005 American Heart Association guidelines for cardiopulmonary resuscitation and emergency cardiovascular care. *Circulation*. 2005; 112(suppl):IV-1–IV-203.
5. Rea TD, Eisenberg MS, Culley LL, Becker L. Dispatcher-assisted cardiopulmonary resuscitation and survival in cardiac arrest. *Circulation*. 2001;104:2513–2516.
6. Bang A, Herlitz J, Martinell S. Interaction between emergency medical dispatcher and caller in suspected out-of-hospital cardiac arrest calls with focus on agonal breathing: a review of 100 tape recordings of true cardiac arrest cases. *Resuscitation*. 2003;56:25–34.
7. Hauff SR, Rea TD, Culley LL, Kerry F, Becker L, Eisenberg MS. Factors impeding dispatcher-assisted telephone cardiopulmonary resuscitation. *Ann Emerg Med*. 2003;42:731–737.
8. Clark JJ, Culley L, Eisenberg M, Henwood DK. Accuracy of determining cardiac arrest by emergency medical dispatchers. *Ann Emerg Med*. 1994; 23:1022–1026.
9. Berdowski J, Beekhuis F, Zwinderman AH, Tijssen JG, Koster RW. Importance of the first link: description and recognition of an out-of-hospital cardiac arrest in an emergency call. *Circulation*. 2009;119: 2096–2102.
10. Krischer JP, Fine EG, Davis JH, Nagel EL. Complications of cardiac resuscitation. *Chest*. 1987;92:287–291.
11. Corbett SW, O'Callaghan T. Detection of traumatic complications of cardiopulmonary resuscitation by ultrasound. *Ann Emerg Med*. 1997;29: 317–321.
12. Culley LL, Clark JJ, Eisenberg MS, Larsen MP. Dispatcher-assisted telephone CPR: common delays and time standards for delivery. *Ann Emerg Med*. 1991;20:362–366.

13. Hallstrom AP, Cobb LA, Johnson E, Copass MK. Dispatcher assisted CPR: implementation and potential benefit: a 12-year study. *Resuscitation*. 2003;57:123–129.
14. Nurmi J, Pettila V, Biber B, Kuisma M, Komulainen R, Castren M. Effect of protocol compliance to cardiac arrest identification by emergency medical dispatchers. *Resuscitation*. 2006;70:463–469.
15. Lerner EB, Sayre MR, Brice JH, White LJ, Santin AJ, Billittier AJt, Cloud SD. Cardiac arrest patients rarely receive chest compressions before ambulance arrival despite the availability of pre-arrival CPR instructions. *Resuscitation*. 2008;77:51–56.
16. Bobrow BJ, Zuercher M, Ewy GA, Clark L, Chikani V, Donahue D, Sanders AB, Hilwig RW, Berg RA, Kern KB. Gasping during cardiac arrest in humans is frequent and associated with improved survival. *Circulation*. 2008;118:2550–2554.
17. Sommers MS. Potential for injury: trauma after cardiopulmonary resuscitation. *Heart Lung*. 1991;20:287–293.
18. Hoke RS, Chamberlain D. Skeletal chest injuries secondary to cardiopulmonary resuscitation. *Resuscitation*. 2004;63:327–338.
19. Aufderheide TP, Pirrallo RG, Yannopoulos D, Klein JP, von Briesen C, Sparks CW, Deja KA, Kitscha DJ, Provo TA, Lurie KG. Incomplete chest wall decompression: a clinical evaluation of CPR performance by trained laypersons and an assessment of alternative manual chest compression-decompression techniques. *Resuscitation*. 2006;71: 341–351.

CLINICAL PERSPECTIVE

Cardiopulmonary resuscitation (CPR) instructions provided over the telephone by the 9-1-1 emergency dispatcher can substantially increase bystander-initiated CPR and thereby increase the chance for survival from out-of-hospital cardiac arrest. Nevertheless, identification of cardiac arrest by dispatchers and bystanders can sometimes be challenging. A number of conditions can resemble cardiac arrest; consequently, patients who are not in cardiac arrest can receive CPR. The risk of bystander CPR for patients not in arrest is uncertain and has implications for how assertive dispatch is in instructing CPR. This article reports on a 2½-year prospective study of dispatcher-assisted CPR in King County, Washington. Of the 1700 patients for whom dispatcher CPR instructions were initiated during the study period, 55% (938 of 1700) were in arrest, 45% (762 of 1700) were not in arrest, and 18% (313 of 1700) were not in arrest and progressed to receive bystander chest compressions. Of the patients not in arrest who received chest compressions, 12% experienced discomfort, and 2% sustained injuries likely or possibly caused by bystander CPR. The injuries were characterized most often by rib fracture, and no patients suffered visceral organ injury. The results of the present investigation indicate that the frequency of serious injury related to dispatcher-assisted bystander CPR among nonarrest patients is low. When coupled with the established benefits of bystander CPR among those with arrest, the results support an assertive program of dispatcher-assisted CPR.

Circulation

American Heart Association

Dispatcher-Assisted Cardiopulmonary Resuscitation. Risks for Patients Not in Cardiac Arrest

Lindsay White, Joseph Rogers, Megan Bloomingdale, Carol Fahrenbruch, Linda Culley, Cleo Subido, Mickey Eisenberg and Thomas Rea

Circulation. published online December 21, 2009;
Circulation is published by the American Heart Association, 7272 Greenville Avenue, Dallas, TX 75231

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

SUPPLEMENTAL MATERIAL

Supplemental Tables

Table I. Characteristics of patients with pain or injuries as a probable consequence of dispatcher assisted bystander cardiopulmonary resuscitation

	Age	Sex	EMS assessment	Transport level	Randomi-zation	Hospital admission	Discharge disposition	Chest imaging study	Nature of injury
Case 1	82	F	Cerebrovascular event	BLS	CC + V	Yes	Discharged alive	X-ray	Pain
Case 2	31	F	Asthma attack	ALS	CC + V	Yes	Discharged alive	X-ray	Pain
Case 3	38	M	Intoxication	BLS	CC + V	ED only	Not admitted	X-ray	Pain
Case 4	82	F	Seizure	BLS	CC alone	Yes	Discharged alive	X-ray	Pain
Case 5	78	F	Syncope	ALS	CC + V	Yes	Discharged alive	X-ray	Pain
Case 6	≥ 90	F	Other illness	BLS	CC alone	Yes	Discharged alive	X-ray	Pain
Case 7	44	F	Other illness	BLS	CC alone	Yes	Discharged alive	X-ray and CT	Pain, clavicular fracture

Case 8	39	F	Overdose	ALS	CC alone	Yes	Discharged alive	X-ray	Pain
Case 9	65	M	Cerebrovascular event	ALS	CC alone	Yes	Discharged alive	X-ray	Pain
Case 10	83	M	Syncope	BLS	CC + V	ED only	Not admitted	X-ray	Pain
Case 11	23	F	Overdose	ALS	CC + V	ED only	Not admitted	X-ray	Pain
Case 12	17	F	Syncope	BLS	CC alone	ED only	Not admitted	X-ray	Pain
Case 13	74	F	Hypoglycemia	BLS	CC + V	ED only	Not admitted	None	Pain
Case 14	89	F	Cerebrovascular event	BLS	CC alone	Yes	Discharged alive	X-ray	Pain, intertro-chanteric fracture of right hip
Case 15	50	M	Overdose	ALS	CC alone	Yes	Discharged alive	X-ray	Pain
Case 16	85	M	Syncope	ALS	CC alone	Yes	Discharged alive	X-ray	Pain, probable anterior rib fractures
Case 17	42	F	Overdose	BLS	CC + V	Yes	Discharged alive	X-ray	Pain

								and CT	
Case 18	19	F	Overdose	BLS	CC alone	ED only	Not admitted	X-ray	Pain
Case 19	45	F	Anxiety induced hyperventilation	BLS	CC alone	ED only	Not admitted	X-ray	Pain
Case 20	76	F	Seizure	BLS	CC alone	Yes	Discharged alive	X-ray	Pain
Case 21	25	F	Overdose	ALS	CC alone	Yes	Discharged alive	X-ray	Pain
Case 22	44	M	Infection and overdose	ALS	CC alone	Yes	Discharged alive	X-ray	Pain, subacute fractures of left 8th, 9th and 10th ribs

* EMS = Emergency medical services

† F = Female

‡ M = Male

§ BLS = Basic life support

|| ALS = Advanced life support

CC + V = Chest compressions plus ventilations

** CC alone = Chest compressions alone

†† ED = Emergency department

‡‡ CT = Computed tomography

Table II. Characteristics of patients with pain or injuries as a possible consequence of dispatcher assisted bystander CPR

	Age	Sex	EMS assessment	Transport level	Randomi-zation	Hospital admission	Discharge disposition	Chest imaging study	Nature of injury
Case 1	62	M	Hypoglycemia	ALS	CC alone	Yes	Discharged alive	X-ray	Pain
Case 2	33	F	Syncope	BLS	CC + V	ED only	Not admitted	None	Pain
Case 3	39	F	Syncope	BLS	CC alone	Yes	Discharged alive	X-ray and CT	Pain
Case 4	50	M	Overdose	BLS	CC alone	Yes	Discharged alive	X-ray	Possible rib fractures
Case 5	16	F	Intoxication	BLS	CC + V	ED only	Not admitted	None	Pain
Case 6	81	M	Decreased LOC unclear etiology	ALS	CC + V	Yes	Discharged alive	X-ray	Pain
Case 7	21	F	Psychological issue	BLS	CC alone	ED only	Not admitted	CT	Pain
Case 8	23	M	Overdose	ALS	CC alone	Yes	Discharged alive	X-ray	Tracheal bleed

Case 9	63	F	Hypoglycemia	BLS	CC alone	Yes	Discharged alive	X-ray	Pain

* EMS = Emergency medical services

† F = Female

‡ M = Male

§ BLS = Basic life support

|| ALS = Advanced life support

CC + V = Chest compressions plus ventilations

** CC alone = Chest compressions alone

†† ED = Emergency department

‡‡ CT = Computed tomography