Improving Patient Outcomes with Compression-Only CPR: Will Bystander CPR Rates Improve?

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Out-of-hospital cardiac arrest is a significant public health problem that affects all communities. Survival rates among these victims remain low despite resuscitative efforts provided by bystanders and emergency personnel. However, there are several factors that positively influence survival after out-of-hospital cardiac arrest: early initiation of cardiopulmonary resuscitation (CPR), good quality of CPR, and early defibrillation.[1] Bystander CPR has been cited as a major factor in increasing chances of survival from out-of-hospital cardiac arrest by 50%.[2] Despite these medical advances, the survival rate for patients having out-of-hospital cardiac arrest remains low. Recent findings in cardiac arrest theory and pathophysiology have led to numerous studies over the past decade. New techniques, such as compression-only CPR (COCPR) and modified prehospital advanced cardiac lifesaving (ACLS) protocols, have been trialed with fascinating results. Other studies have investigated factors associated with low bystander CPR rates. This article will examine the relationship between the new COCPR findings and how incorporating this research in the public sector may positively influence bystander CPR rates.

Overview of the Problem

Current CPR guidelines instruct rescuers to perform chest compressions and mouth-to-mouth ventilations to a victim of cardiac arrest at a ratio of 30:2 and at a rate of 100 compressions per minute. When an automated external defibrillator (AED) is available, rescuers should follow the programmed instructions and administer electrical shocks to the victim. Recent research has questioned the true effectiveness of the current CPR guidelines in the resuscitation of an out-of-hospital cardiac arrest victim. Investigators have found that mouth-to-mouth ventilations inflict harm to the victim by causing gastric insufflations.[3] Hyperventilation of the victim caused by ventilations is a common occurrence that causes an increase in intrathoracic pressure resulting in decreasing coronary perfusion pressure in cardiac arrest victims.[4] Studies have shown that the time spent performing ventilations takes precious time away from performing the crucial chest compressions that support cerebral and coronary perfusion. Human and animal studies report that coronary perfusion pressures and left ventricular blood flow are decreased as a result of ventilations given during CPR.[5] Similarly, additional "hands-off time" is spent attaching the AED, waiting for cardiac rhythm analysis, and administering a shock. Investigators have found that when rescuers performed CPR, including use of the AED, they provided effective chest compressions less than 50% of the time.[4] Compounding this problem is a low bystander CPR rate. Research has indicated that community CPR classes have educated an estimated 12% to 64% of the general population, yet actual bystander rates of CPR performed in the public sector are only 15% to 30%.[1] These researchers found that bystanders were reluctant to perform CPR for a variety of reasons including unappealing attributes of the victim, fear of litigation, transmission of infectious diseases from the victim, or performing CPR incorrectly. In addition, conventional CPR is a complex skill and is difficult to teach, and its complexity intimidates many potential rescuers.[3]

Significance and Relevance of the Problem

Cardiac arrest is a significant health issue that is at the forefront of public interest and medical research. Approximately 55 in 100,000 people suffer from cardiac arrest each year in the Unites States and Canada, resulting in more than 173,000 annual deaths, with a survival rate of less than 5%.[6] Out-of-hospital cardiac arrest and the sub-

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sequent low survival rates are a significant public health problem. Recent research has indicated that the current method of out-of-hospital resuscitation is inferior when compared with the new treatment modalities, such as modified CPR and ACLS techniques. Coupled with low bystander rates of CPR, a victim of cardiac arrest outside of the hospital has a dismal chance of survival.

Review of the Epidemiologic Studies

A great deal of research has been performed over the past decade regarding the efficacy of COCPR versus the traditional form of CPR (TCPR), which incorporates a combination of chest compressions and mouth ventilations. Recent studies have examined success rates of prehospital COCPR and revised ACLS protocols that emphasize compressions instead of ventilations. Additional research has investigated bystander CPR rates and the reasons for not administering CPR to victims of out-of-hospital cardiac arrest. Synopses of some of these articles are as follows:

COCPR RESEARCH

A prospective, multicenter observational study performed in Japan investigated the technique of bystanders performing CPR in cases of out-of-hospital cardiac arrest and assessed the neurologic outcomes of those victims receiving the different forms of CPR.[3] Bystander CPR was performed in 1,324 cases (31%). The type of bystander CPR was documented in 1,151 cases; of these, 439 received COCPR and 712 received TCPR. The results indicated that bystander COCPR was superior to TCPR in adult patients with witnessed cardiac arrest in terms of neurologic benefits. The neurologically normal survival rate at 30 days after arrest was 8.2% for those who did not receive bystander CPR, 11.2% for those who received TCPR, and 19.4% for those who received COCPR. There was no evidence of benefit from the addition of mouth-to-mouth ventilations in any subgroup of the patients studied. COCPR and TCPR provided favorable neurologic benefits when compared with those who received no bystander CPR.

A study performed in Seattle, Washington, compared patient survival rates to hospital discharge and neurologic function in victims of out-of-hospital cardiac arrest receiving COCPR versus TCPR and the length of time required for dispatcher-provided instructions for each.[2] In this clinical trial, 241 patients were randomly assigned chest compressions alone and 279 patients were assigned to chest compressions plus mouth ventilations by emergency dispatchers. The results indicated that dispatchers were able to provide complete instructions 62% of the time in TCPR patients and 81% of the time in COCPR patients. Instructions for COCPR required 1.4 minutes less to complete than those for TCPR. The rate of survival to hospital discharge was better among patients assigned to COCPR versus TCPR (14.6% vs 10.4%).

A randomized, controlled simulation study was performed in North Carolina that assessed quality and frequency measures of subjects when they performed randomly assigned COCPR versus TCPR, as well as whether the subjects had fatigue and understood the phone instructions provided by the dispatcher.[5] A convenience sample of 50 English-speaking visitors in an emergency department with no prior CPR training agreed to participate in this study. Two groups of 25 test subjects were randomly assigned to either perform COCPR or TCPR. Manikins were used to objectively measure CPR efficacy. The results of this study indicated that the COCPR group initiated cardiac compressions faster, completed 4 cycles of CPR faster, and paused for a smaller percentage of the resuscitation when compared with the TCPR group. There were no differences in perceived instructions or fatigue level by either group. Of these subjects, 86% stated that they understood the CPR instructions given to them, but objective data obtained from the manikins revealed that the CPR technique was poor for both groups.

MODIFIED PREHOSPITAL ACLS RESEARCH

A study performed in rural southwestern Wisconsin compared neurologically intact survival rates of out-of-hospital cardiac arrest victims receiving 2 different protocols of resuscitation over a 6-year period in 2 cohorts of patients.[7] In the first cohort, data during a 3-year period from 2001 to 2003 were collected retrospectively from patients having out-of-hospital cardiac arrest. This standard-care group received treatment following the 2000 American Heart Association guidelines. In the second treatment group, data were collected prospectively from patients having out-of-hospital cardiac arrest between the years of 2004 and 2007 via a new resuscitation protocol. The new protocol for the second cohort of patients required 2 minutes of uninterrupted or continuous chest compressions at a rate of 100 per minute before each rhythm analysis with or without shock. Single instead of stacked shocks were used, with continuous chest compressions immediately following. Pulse checks were performed only after 200 compressions during the obligatory pause during rhythm analysis. Initial airway management was delayed until a second rescuer had arrived and then was limited to the placement of an oral-pharyngeal airway and administration of oxygen via a non-rebreather mask. If the initial rhythm was shockable, insertion of an invasive airway and assisted ventilation were not performed until either a return of spontaneous circulation occurred or after 3 cycles

of continuous chest compressions and analysis with or without shock were completed. If the initial rhythm was not shockable, invasive airway insertion and ventilation were initiated after the first rhythm analysis, with positive-pressure ventilations at a rate of 8 to 10 per minute. Neurologic outcomes for survivors were measured shortly after hospital discharge based primarily on review of hospital records. A cerebral performance score was recorded for each survivor, and subjects deemed neurologically intact for this study were conscious, alert, able to work, and able to live a normal life but may have had minor psychological or neurologic deficits. During the 3 years when the 2000 American Heart Association guidelines were used, 92 adult patients met the criteria for this study. Of these 92 patients, 18 survived (20%), and 14 of these 92 (15%) survived neurologically intact. During the 3 years when the revised resuscitation was used, 89 patients were included in this study. Of these 89 patients, 42 survived (47%), and 35 of these 89 (39%) survived neurologically intact.

A retrospective observational cohort study performed in Kansas City, Missouri, compared survival rates and neurologic outcomes of patients with out-of-hospital cardiac arrest for those who had historically received a TCPR and ACLS protocol versus those receiving a new, modified method of CPR and ACLS.[4] A total of 1,466 adult patients were studied in the historical cohort (receiving TCPR), and 492 adult patients received the modified version of resuscitation. All patients were identified as having cardiac arrest that was cardiac in origin and were identified as having ventricular fibrillation as the presenting cardiac rhythm upon paramedic arrival at the scene. Two cohorts were studied. In the first group (historical cohort), the investigators studied outcomes from patients who had CPR performed at a 5:1 compression-ventilation rate and the traditional standards of ACLS. In the second group (revised-protocol cohort), a new resuscitation protocol was developed. The compression-ventilation rate was increased to 50:2, and patients received 200 chest compressions before rhythm analysis and shock from a defibrillator. Continuous oxygen was applied to the victim via a non-rebreather mask with an oral airway between ventilations, and intubation was not attempted until the third round of compressions. Ventilations administered were gentle, taking no longer than 2 seconds; intubation attempts could take no longer than 10 seconds; and a maximum of 3 intubation attempts were allowed. No drugs were administered via endotracheal tube. Results from this study indicated that survival from out-of-hospital cardiac arrest increased from a rate of 7.5% (82 of 1,097) in the historical cohort to 13.9% (47 of 339), with an odds ratio (OR) of 1.8, in the revised-protocol cohort ($P < .001$). Survival to hospital discharge also improved from a rate of 22.4% (32 of 143) to 43.9% (25 of 57) in the revised-protocol cohort, with an OR of 2.71 ($P < .0024$). Of the 25 patients who survived to hospital discharge, 88% had favorable cerebral performance categories. Interestingly, intubation of cardiac arrest patients in this study was associated with decreased survival rates (OR, 0.41).

BYSTANDER CPR RESEARCH

A systematic review of experimental and non-experimental studies published on bystander CPR was performed by researchers and included 252 articles.[6] These articles included randomized controlled trials, quasi-experiments, observational studies, and literature reviews. The investigators grouped studies pertaining to who should learn CPR, what should be taught, when to repeat training, where to give CPR instructions, and why people lack the motivation to learn and perform CPR. These studies were grouped according to topic, and the findings were summarized. At the end of each topic, the investigators included a statement along with a measure of the quality of evidence supporting it. The results of this study indicate that targeted efforts are needed to recruit learners most likely to witness cardiac arrest, and reassurance needs to be emphasized to learners regarding the low incidence of contagious disease transmission when performing CPR. In addition, CPR classes need to be targeted and shortened, learners need more time to practice on manikins, and improved strategies to provide dispatcher-assisted CPR instructions should be developed.

An Australian study investigated the psychological and socioeconomic factors that may inhibit confidence of family members to initiate CPR.[1] This cross-sectional descriptive study investigated 1,208 adults. A random selection of 602 men and 606 women participated via telephone survey using an omnibus survey format. Results indicated that the difference between the confident and not confident groups was significant ($P < .001$). Those who had learned CPR were significantly more confident to initiate CPR on a family member than those who had not (68.4% vs 31.6%) (OR, 11.16); men were more confident than women (75% vs 61.7%) (OR, 1.53); adults aged 25 to 64 years were more confident than those younger or older in performing CPR (76% vs 52% and 60% for those aged ≥65 years and those aged 18-24 years, respectively); and individuals with an annual income of greater than $100,000 were more confident to initiate CPR on a family member, whereas those with an annual income of less than $26,000 were the least confident (85.1% vs 62.8%) (OR, 2.03). A fear of failing and anxiety about performing CPR correctly were 2 main reasons provided by subjects as to why they would not perform CPR.

Implications for Health Care

Implications of this research have profound effects at the point of care. These studies have indicated that patient survival rates and neurologic outcomes are improved between those receiving COCPR versus TCPR. In addition, less hands-off time is considered to be a significant contributor to improved survival rates during prehospital CPR among victims of cardiac arrest.[8] If survival and improved patient outcomes are related to the quick provision of CPR and sustained circulatory support, then COCPR may prove to be the method of choice in resuscitative efforts during the first few minutes of CPR.[5] In addition, removing mouth-to-mouth ventilations may increase CPR compliance of bystanders.[9] The simplicity of administering COCPR may not only prove to be easier to teach, but it may also be easier to learn by laypersons. By eliminating the complexity of CPR, the fear of performing this skill incorrectly, as identified by the study of Dwyer[1]—would likely be lessened.

Implications for Program Development

CPR classes can be modified to reflect the results of current research findings. Research recommends that community CPR class content be simplified and condensed with learners needing more hands-on practice with a manikin.[6] If the ventilation component of bystander CPR was removed, programming for CPR classes would become much more straightforward. Classes could focus primarily on the proper mechanics of chest compressions, such as correct hand placement, rate, and depth. To address some of the psychological components of administering CPR, an emphasis on what the victim of cardiac arrest may look like or what bodily functions may occur during cardiac arrest would better prepare rescuers for what they may encounter. In addition, a discussion of how the stress of administering CPR and the outcomes of the rescue may emotionally impact the rescuer would be beneficial for learners. Addressing bystander fears regarding infectious disease transmission is also imperative during class instruction. To reach a wider audience, the exploration of self-study classes by use of instructional DVDs with manikin rentals may help to increase public CPR education. Peer education may also prove beneficial.

It is important to target teaching modalities to members of the community who are less likely to administer CPR. As cited in the study of Dwyer,[1] groups with the least amount of confidence in performing CPR include the very young adult population, persons aged over 65 years, women, and persons with low annual incomes. Public service announcements and marketing strategies that promote this simplified CPR technique could be aimed at these demographics. In addition, funding for very low–cost or free CPR classes could also be offered for low-income members of the community.

Local emergency providers should be aware of the psychological impact on bystander rescuers who perform CPR on cardiac arrest victims. Axelsson[10] found that bystanders had negative reactions with an OR of 9.6 when there was a lack of debriefing after a resuscitation attempt. This study reveals that debriefing is a strongly significant independent factor that influences the bystander's reactions in a rescue attempt.

Emergency dispatch centers are also affected by these findings. Vaillancourt et al[6] recommended that improved strategies be made to provide simpler 911 dispatcher–assisted CPR instructions for laypersons faced with an out-of-hospital cardiac arrest victim. A study performed in Norway found a significantly shorter hands-off time in rescuers who used video phone technology during their instruction of CPR.[9] To recognize the growing population that uses video phone technology, enhancements to current technology would be required of 911 centers to accommodate this new teaching modality.

Implications for Further Research

Studies have indicated improved patient outcomes associated with COCPR. Despite these encouraging findings, continued research needs to be performed on ventilation rates and frequencies, as well as the effect on cardiac output, intrathoracic pressure, neurologic status, and survival rates. A prospective, randomized clinical trial would provide the best information regarding this. Further studies should be performed comparing the efficacy of TCPR versus COCPR for victims of cardiac arrest with etiologies other than cardiac, including drug overdoses, asphyxia, alcohol intoxication, carbon monoxide poisoning, and so on. The study performed by Hallstrom et al[2] noted that survival rates in this subgroup of patients comparing both types of CPR were similar (80.7% in TCPR group vs 75.7% in COCPR group). Pediatric studies comparing outcomes using the 2 forms of CPR would be beneficial as well. If and when resuscitation protocols change to COCPR, a study investigating whether bystander CPR compliance increases would be extremely noteworthy. Additional studies using the Kansas City, Missouri, or Wisconsin modified CPR/ACLS protocol should also be investigated.

Implications for Emergency Nursing

Emergency nurses frequently care for patients at high risk for cardiac arrest. As cited by Vaillancourt et al[6] in their review of CPR literature, targeted efforts need to be made

to recruit learners of CPR who are most likely to witness cardiac arrest. Because family members are most likely to witness an out-of-hospital cardiac arrest,[1] "teachable moments" could be used by nurses to suggest enrollment in a CPR class. Emergency nurses could provide patients and family with explanations regarding the importance of CPR training and facilitate answers to questions that would help to alleviate the fears and misconceptions associated with administering CPR. Emergency nurses could also work with the educators within the hospital setting to develop a hospital-based CPR class for families that would be available at minimal or no cost.

As evidenced by the research, initial responders to out-of-hospital cardiac arrest had negative reactions when debriefing did not occur.[10] Armed with this knowledge, emergency nurses could take steps to ensure that family members and bystanders who were likely to have been directly involved in the resuscitation efforts are debriefed, either by ED staff members or by consultation with social work or chaplain staff. Providing an outlet for discussion, support, and reassurance could help rescuers to move forward and view the experience in a more positive light.

COCPR research indicates improved patient outcomes when compared with TCPR. The knowledge gained by this research can assist emergency nurses to continue to place more emphasis on excellent cardiac compression technique and closely monitor the hands-off time during resuscitation efforts in the emergency department. As emergency nurses, we spend much time, effort, and anguish caring for victims of out-of-hospital cardiac arrest and their loved ones. If we are now able to provide treatment for a greater number of survivors of this condition, nursing care can focus on the positive aspects of patient recovery and help to provide these patients and their loved ones with a second chance at life.

Conclusion

Research within the past decade regarding cardiac arrest and its implications for victims, bystanders, and rescuers has given pause to medical investigators, especially in terms of assessing current cardiac arrest treatment modalities. If continued research supports the current findings of improved outcomes using COCPR, current methods of CPR using mouth-to-mouth ventilations may be eventually deemed obsolete during the first few minutes of resuscitation. By eliminating mouth-to-mouth ventilations in bystander CPR instruction, the current complexity of this training would be simplified and intimate mouth-to-mouth contact between the victim and rescuer would be eliminated. If this change would occur, bystander CPR rates could potentially increase, which would then lead to a rise in survival rates for out-of-hospital cardiac arrest victims. Any improvement in patient survival rates, especially those that favor neurologic outcomes, would prove to be beneficial for public health worldwide.

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