Major predictors of survival of patients with out-of-hospital primary cardiac arrest are witnessed collapse and a shockable rhythm. Since early bystander initiated resuscitation efforts prolong the electrical or shockable phase of untreated ventricular fibrillation, areas with higher rates of early-onset bystander resuscitation efforts and shorter emergency medical services (EMS) response times have higher survival rates.\(^1,2\) These areas enjoyed and enjoy acceptable early-onset bystander resuscitation efforts and shorter emergency medical services (EMS) response times. Since early bystander initiated resuscitation efforts and shorter EMS response times are not present in most areas, the survival of individuals with out-of-hospital cardiac arrest (OHCA) overall remains suboptimal.\(^3,4\)

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In an effort to improve survival, chest compressions only for bystanders was advocated in the 1990s, and modifications of the 2000 guidelines for EMS providers were instituted by the Sarver Heart Center Resuscitation Research Group in 2003.\(^7-11\) The major elements of the EMS modifications were (1) eliminating the decades-long emphasis on early intubation and positive pressure ventilations, (2) eliminating the recommendation for immediate defibrillation and the use of stacked shocks, (3) eliminating all unnecessary interruptions of chest compressions, and (4) advocating chest compressions before and immediately after a single defibrillation shock, and the early administration of epinephrine.

This approach for patients with OHCA was called cardiocerebral resuscitation,\(^8\) to differentiate it from cardiopulmonary resuscitation, which we think should be reserved for cardiac arrest secondary to respiratory arrest or failure. Our first 2 outcomes reports using cardiocerebral resuscitation were published by Kellum and associates.\(^12,13\) In the first report from Rock and Walworth counties in Wisconsin, survival of patients with OHCA and an initially shockable rhythm was 18/92 (20%) in the previous 3 years when the 2000 guidelines were followed and was 19/33 (57%) in the first year of cardiocerebral resuscitation.\(^12\) Neurologically intact survival was 16/33 (48%) during the first year.\(^12\)

It was very difficult to get this report published because, frankly, the results were just too good to believe. No previous change in guidelines had ever shown such a dramatic improvement in survival.\(^12\) Reviewers thought that the improvement was due to the Hawthorne effect. In fact, either a minor Hawthorne effect was present or emphasis on continuing EMS education was reduced, because in the second report, with 3 years of follow-up, the survival to hospital discharge of patients with witnessed OHCA and a shockable rhythm treated with cardiocerebral resuscitation was 42/89 (47%) and neurologically intact survival was 35/89 (39%).\(^13\)

These outcomes are remarkably similar to those reported in this issue of Circulation by Garza and associates from Kansas City, Mo.\(^14\) They found survival was 32/143 (22%) during the previous 3 years when the 2000 guidelines were followed and 25/59 (44%) in the year after the institution of their modifications.\(^14\) Survival with favorable neurological outcome during that year was 22/59 (38%).\(^14\)

As Garza and associates indicated, their approach employed “strategies implemented by the Tucson Fire Department and then by Kellum and associates in Wisconsin.”\(^14\) The rationale and early results of using cardiocerebral resuscitation (including chest compression only for bystander CPR, referred to as “call and pump” by the Wisconsin group and as continuous chest compressions by our group) were presented by Drs Ewy and Kellum on October 29, 2005, at a symposium hosted by the Kansas City Health Department, St. Luke’s Hospital, and Anne Peterson Productions. The final protocol adopted by the EMS system in Kansas City, Mo, was essentially cardiocerebral resuscitation, with the exception that they attempted to prevent the adverse effects of hyperventilation by allowing only 2 “gentle ventilations” after every 50 chest compressions instead of passive oxygen insufflation. When asked about the reason for this change, Dr Garza e-mailed me that their group did not think the paramedics would accept both not intubating and not ventilating their patients.

A similar concern was expressed after we presented cardiocerebral resuscitation as an alternative approach to the 2000 guidelines to the EMS physicians and directors in the Phoenix metropolitan area in Arizona. The Arizona team likewise believed that if the paramedic firefighters were told they could neither intubate nor ventilate by bag mask but had to use passive oxygen insufflation, a significant departure from all previous guidelines, they might not accept the...
cardiocerebral resuscitation protocol. Accordingly the Phoenix metropolitan EMS systems paramedic/firefighters were given the option of using either passive oxygen insufflation or bag mask ventilation. The results of this approach were published as “Minimally Interrupted Cardiopulmonary Resuscitation.” When minimally interrupted cardiopulmonary resuscitation was used, survival of patients with witnessed OHCA and a shockable rhythm improved from (46/387) 12% to (40/141) 28%. Although this improvement in survival was significant and gratifying, it was not as good as the data from Kellum and associates in Wisconsin, who reported neurologically intact survival of 39% using passive oxygen insufflation. The question then was, did the mode of ventilation make a difference? The answer is that it apparently did. We found that the survival rate from out-of-hospital cardiac arrest was superior with passive oxygen insufflation compared with active assisted ventilation. Survival of patients in Arizona treated with cardiocerebral resuscitation (eg, including passive oxygen insufflation) was similar to that reported by Kellum et al and by Garza et al.

A legitimate concern about all of these reports is that cardiocerebral resuscitation was compared with the 2000 and not with the 2005 guidelines. This concern is justified, given that the 2005 guidelines incorporated 2 of the changes that we instituted in cardiocerebral resuscitation in 2003. Specifically, the 2005 guidelines advocated single rather than stacked shocks and 200 chest compressions immediately after defibrillation. Rae and associates reported that these 2 changes alone improved survival in their hands. To date, no randomized controlled study has compared survival of patients treated with these 2 approaches. However, the federally funded Research Outcomes Consortium, a group of arguably some of the better EMS systems in the United States and Canada, recently reported survival to hospital discharge of patients with OHCA that varied from 8% to 40%, with a median of only 22%. Their analysis was from March 2006 to February 2007, when these EMS systems were following the 2005 guidelines.

More recently, investigators from Norway reported a survival rate of 27% when following the 2000 guidelines and 31% when following the 2005 guidelines, a nonsignificant increase. Likewise, the survival in King County, Wash, was not significantly improved during the 2005-to-2006 period compared with the 1999-to-2004 period.

Should we wait for the 2010 Guidelines to make changes? Some of the criteria previously used to develop resuscitation guidelines, such as the grandfathering of previous recommendations while requiring published randomized controlled trials for change and the relegation of survival studies in animals to a very low level of evidence might well preclude the 2010 guidelines, like previous guidelines, from being optimal. It is always scientifically correct to say that we must wait for randomized controlled trials in humans, but is it always morally correct? In resuscitation research, the cost of such studies and the difficulty of obtaining informed consent might well preclude or significantly delay such trials.

Where do we go from here? Ornato and Peberdy have pointed out that advances in EMS have traditionally been made by systems that document their results, make changes, and document the outcome. However, what changes should be made? The changes that resulted in cardiocerebral resuscitation were made only after each was shown by us or by others in realistic animal models of OHCA—or in observational studies—to improve survival.

We recommend that each EMS system measure the survival to hospital discharge of that subset of patients most likely to survive: those with witnessed arrest and a shockable rhythm. If the survival of this group does not approach 40%, room for improvement exists and changes in their EMS protocol should not wait. Cardiocerebral resuscitation has now been shown to improve survival in 3 communities that include both urban and rural EMS systems. Hundreds of lives have been saved in Wisconsin, Arizona, and now in Kansas City since its institution.

Disclosures

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