Cardiac Arrest
Survivors or Still Victims?
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Worldwide, out-of-hospital cardiac arrest remains a life-losing proposition for the vast majority of its victims. In the United States,prehospital emergency medical services (EMS) personnel attend an estimated 273,000 persons with out-of-hospital cardiac arrest (defined as circulatory or pulseless collapse) each year. Survival to hospital discharge from all presenting rhythms of cardiac arrest remains strikingly poor (median survival 6.4%) but varies widely across communities. The reasons for this wide variation in outcome are likely due in part to community differences in patient characteristics, bystander involvement, and EMS structure and care. This variation is also confounded by the nonuniform manner in which cardiac arrest itself is ascertained and reported.

Seven years ago, representatives from the American Heart Association, the European Resuscitation Council, the Heart and Stroke Foundation of Canada, and the Australian Resuscitation Council met to establish a uniform method of defining and reporting out-of-hospital resuscitation. The intent of the resulting Utstein Style reporting template was to lay a common foundation that could characterize cardiac arrest, benchmark care within a community, and facilitate comparisons across systems or communities, all in an effort to improve outcomes from out-of-hospital cardiac arrest. Using the Utstein schema, one begins with the population served by EMS, tabulates all cardiac arrests attended by EMS, and excludes those in whom resuscitation was not attempted or for whom cardiac arrest was due to obvious noncardiac causes. The focus of the template is the remaining group of patients with cardiac arrest of presumed cardiac origin in whom resuscitation was attempted. These patients serve as the “denominator” in the modified Utstein template for evaluating outcome. Patients who compose this denominator are further stratified by their witnessed arrest status and initial rhythm, then characterized by the location of their arrest (whether in a public place or not), the provision of bystander cardiopulmonary resuscitation (CPR) or public access defibrillation, and outcome (return of spontaneous circulation, survival to hospital admission, and vital and neurological status at hospital discharge). Other important details include patient demographics (age, gender) and EMS response intervals (the intervals from dispatch of EMS to their arrival at the scene of the arrest and initiation of treatment). This model provides the basic framework to track progress, evaluate the impact of new treatment modalities, or provide quality assurance within and between EMS systems. A well-executed Utstein registry can also serve to help interpret temporal trends in outcome from cardiac arrest and enable one to identify the potential causes for temporal changes in outcome. Such changes in outcome over time may be due solely to circumstantial factors that are beyond EMS control (such as an aging population) or to system factors that can potentially be improved (such as EMS response times, public access defibrillator use, or the provision of bystander CPR). Finally, such a schema insures that one is truly comparing “like with like” when outcomes from cardiac arrest are reported from different communities.

The report in this issue by Hollenberg and colleagues illustrates the impressive nature of the Swedish Cardiac Arrest Registry, in which a full profile of Utstein elements are collected in a large population and the amount of missing data appears to be modest. The energy, collaboration, and rigor to maintain such a large multicommunity registry over time are substantial. The authors in turn appropriately and usefully report the data stratified by a variety of clinical status subgroups related to the Utstein elements. However, these subgroups omit some of the core Utstein categories used as metrics by many other communities, namely, treated cardiac arrest due to heart disease and bystander-witnessed arrest due to heart disease that presents with an initial rhythm of ventricular fibrillation. The rationale for their omission may be in part to provide a comprehensive nationwide approach that includes all treated cardiac arrest. Nonetheless, separate reporting of these specific established Utstein subgroups would provide a more useful context for the results of this study for many communities.

The report also exemplifies some of the potential challenges in using registries to examine temporal patterns in outcomes from cardiac arrest. This large observational study describes a significant temporal improvement in 1-month survival from treated, out-of-hospital cardiac arrest due to any cause in Sweden. Overall survival increased from 4.8% in 1992 to 7.3% in 2005 ($P<0.0001$) and was particularly evident in patients who presented with a shockable rhythm, for whom survival improved from 12.7% to 22.3% during that time period ($P<0.0001$). As such, this finding is a potentially important observation of temporal improvement.
in a very large population that could represent meaningful public health gains. Improved survival was achieved despite adverse temporal trends in some patient and arrest characteristics that have also been observed in other population-based investigations of cardiac arrest, including a temporal trend toward older age, a decrease in the incidence of ventricular fibrillation as the presenting rhythm, and an increase in EMS response intervals. These adverse trends were offset by favorable temporal trends of an increase in the frequency of bystander CPR and the proportion of arrests witnessed by EMS personnel. In the Swedish study, the increases in EMS-witnessed arrests and, to a lesser degree, citizen CPR were judged to be the most important measured contributors to improved survival.

The significance of these findings and their applicability to other communities is perhaps best interpreted in the context of the Utstein framework. This framework begins with describing the population served by EMS. The Swedish Ambulance Cardiac Arrest Registry, from which this study was derived, is described as having been started in 1990 with a few ambulance services and subsequently successively joined by the majority of services, so that by the time of the present report, it included ~70% of ambulance services in Sweden. Knowledge of the exact composition of the registry over time is critical to interpreting the observed improved outcome from cardiac arrest. The reasons for the temporal improvements may indeed be appropriately identified by the investigators in this report; however, another possibility is that the survival changes were due in part to the influence of an expanding base of cardiac arrest patients and the differing mix and characteristics of ambulance services (perhaps some rural, some suburban, and others urban) that contributed to the registry in its earlier versus later years. In a prior publication, the authors examined these temporal trends through 2003 using the registry but restricted the analysis to ambulance services that participated consistently over time. In that report, they found little evidence of a temporal change in survival. Might the changing composition of the registry’s participating ambulance services account for some of the temporal trends in outcome reported now?

Circumstances surrounding cardiac arrest, such as the provision of CPR by a citizen bystander or its occurrence after EMS arrival, are known to be associated with a more favorable outcome. Over the time period spanned by the registry, bystander CPR increased from 31% to 50% of cases, whereas the frequency of EMS-witnessed arrest rose from 9% to 15%. These are important trends but appear unlikely in and of themselves to account for the reported near doubling of survival from cardiac arrest. This begs the question of whether there might have been other unmeasured contributors to survival outcome. For example, in the present report, EMS response intervals increased over time. The authors suggest that this increase may have been due to a decrease in ambulance density. Might fewer ambulance crews per population have increased individual provider experience and hence the quality of resuscitation performed by EMS? Alternatively, many of the larger communities of Sweden have undertaken prospective evaluations of specific and important research questions over the past decade. Might the attention and efforts generated by these prospective and formally planned investigations have positively affected care and outcome?

Finally, the Utstein elements provide for ease of measurement but at the potential sacrifice of a more comprehensive, qualitative capture of data elements. For example, we have recently begun to appreciate that the provision of CPR by citizens or EMS is not a simple categorical (yes/no) variable. Rather, CPR is likely characterized by a dose and/or quality measure that is not yet completely defined nor easily measured. Might the quality of the discrete Utstein elements that were collected (such as CPR) have changed sufficiently in character over time so as to improve survival but without this effect being captured by a simple categorical classification scheme? Taken together, these principles exemplify the complex nature of resuscitation and the potential relationship of multiple factors to its success, including those measured, those not, and those measurable only in part.

Improving outcome from out-of-hospital cardiac arrest is a formidable challenge. To successfully address the challenge, we must be able to characterize care and outcome using a common approach that enables meaningful interpretation across communities and research endeavors. For its limitations, the Utstein Style provides this framework and is an important foundation for future progress. Likewise, the large experience from the Swedish Ambulance Cardiac Arrest Registry provides interesting findings and encouragement about the prospects for improving the outcome from cardiac arrest. This experience also underscores the gaps in our present understanding of resuscitation. Going forward, resources represented by the registry and the recently created Resuscitation Outcomes Consortium may further refine our understanding of this important public health issue through a greatly expanded knowledge base and the performance of multicenter randomized, clinical trials in cardiac arrest. Applying and building on the core findings that emerge from these endeavors (for example, by encouraging patients to promptly summon EMS for sudden worsening of cardiovascular symptoms and promoting the performance of bystander CPR) may one day indeed result in fewer victims of cardiac arrest and more survivors.

Disclosures

None.

References


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