Survival Following In-Hospital Cardiopulmonary Resuscitation Has Not Improved and Remains Lower Among Black Patients

Ehlenbach WJ, Barnato AE, Curtis JR, et al. Epidemiologic study of in-hospital cardiopulmonary resuscitation in the elderly. N Engl J Med 2009;361:22–31.

Study Overview

Objective. To determine whether survival rates following in-hospital cardiopulmonary resuscitation (CPR) are improving and which patient and hospital characteristics predict survival.

Design. Epidemiologic study of in-hospital CPR in older adults in the United States from 1992 through 2005.

Setting and participants. Patients 65 years of age or older who received in-hospital CPR were identified though analysis of all Medicare Provider Analysis and Review (MedPAR) hospital claims from 1992 through 2005. Receipt of in-hospital CPR was defined as the presence of either of 2 ICD-9 procedure codes: 99.60 (cardiopulmonary resuscitation, not otherwise specified) or 99.63 (closed chest cardiac massage). Analysis was restricted to patients who received Medicare through the Old-Age and Survivors Insurance program. Patients who received Social Security Disability Income and patients who were coenrolled in a health maintenance organization were excluded. For patients who received CPR more than once, only the first occurrence was analyzed.

Main outcome measures. The primary outcome was survival to hospital discharge. Patient predictors included age, sex, race, chronic coexisting illness, median income for the zip code of the patient's residence, and admission from a skilled nursing facility. Hospital predictors included hospital size, metropolitan or nonmetropolitan location, and whether the hospital was a teaching hospital affiliated with a medical school. The influence of individual hospitals on survival to discharge was also examined.

Main results. The study identified 433,985 patients who underwent in-hospital CPR, of whom 18.3% survived to hospital discharge (95% confidence interval [CI], 18.2–18.5). In unadjusted analysis, survival rates were lower for patients who were men, were older, were of black or other nonwhite race, were admitted from a skilled nursing facility, had higher chronic illness burden, and patients who received care in a metropolitan or teaching hospital. Survival rates were slightly higher for patients who received a diagnosis of myocardial infarction or congestive heart failure during the hospitalization in which CPR was administered. There was no significant change in survival over time on crude analysis (P = 0.57) or after adjustment for diagnosis (P = 0.86). The cumulative incidence of in-hospital CPR was 2.73 events per 1000 admissions, and this incidence did not change substantially over the study period. The incidence of CPR was lower among white patients (2.53 events per 1000 admissions) than among black patients (4.35 events per 1000 admissions) or patients of other races (3.85 events per 1000 admissions). The proportion of hospital deaths that occurred among patients who had undergone CPR increased from 3.8% in 1992 to 5.2% in 2005 (P < 0.001). In multivariable analysis including all characteristics significantly associated with survival, the

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odds of survival to hospital discharge remained lower for black patients (OR, 0.70 [95% CI, 0.67–0.73]; $P < 0.001$) and other nonwhite patients (OR, 0.85 [95% CI 0.82–0.89]; $P < 0.001$) when compared with white patients. In a second multivariate model that was adjusted for the hospital in which CPR was performed, the association between black race and lower odds of survival was slightly attenuated (OR, 0.76 [95% CI, 0.74–0.79]; $P < 0.001$). Variability in survival among patients at different hospitals was significant ($P < 0.001$).

Conclusion. Survival after in-hospital CPR did not change from 1992 through 2005. Rates of in-hospital CPR have remained fairly constant, but the proportion of in-hospital deaths preceded by CPR has increased. Black race is associated with higher rates of in-hospital CPR but lower rates of survival after CPR.

Commentary

Despite attempts to improve the delivery of cardiopulmonary resuscitation, rates of survival after in-hospital CPR have not increased. The authors offer several possible explanations for this finding. Most changes in CPR over the study time period have affected its delivery outside the hospital (ie, widespread CPR by bystanders and the increased availability and use of automated external defibrillators in public places). Furthermore, changes in the type and severity of underlying acute illness leading to CPR in the hospital (eg, an increase in the incidence of severe sepsis) could have led to an increase in the percentage of patients receiving CPR whose initial rhythm at the time of cardiac arrest was associated with lower survival (ie, asystole or pulseless electrical activity, as compared with ventricular fibrillation or ventricular tachycardia).

While the authors found no substantial change in the incidence of CPR over the study period, they were surprised by the finding of an increase in the proportion of in-patient deaths preceded by CPR. This trend was mirrored by an increase in the proportion of all deaths preceded by CPR and therefore could not be explained by an increase in the number of deaths occurring outside the hospital. A more likely explanation is that physicians are administering more CPR to patients who are unlikely to survive resuscitation. More than 30 years after do-not-resuscitate (DNR) orders were introduced in American hospitals, meaningful discussions between physicians and patients regarding resuscitation preferences remain rare [1]. Many patients continue to hold unrealistic beliefs about survival following in-hospital CPR, due in part to unrealistic portrayals of its efficacy on television and in the media [2,3]. This study's finding that less than 1 in 5 older patients who underwent CPR in the hospital survived to discharge is an important piece of information for providers to offer patients when discussing hospital resuscitation preferences.

The finding of higher rates of CPR but lower rates of survival among black patients also warrants careful consideration. Survival remained lower among black patients in this study even after adjustment for patient and hospital factors, and was only slightly attenuated after adjustment for the individual hospital. Multiple studies have documented differences in end-of-life treatment preferences by race/ethnicity, with more black patients preferring intensive interventions such as CPR [4,5]. It is possible that survival rates are lower because more black patients who have a low likelihood of survival are choosing to be resuscitated. However, it is also possible, as the authors point out, that variations in the quality of care—at either the individual patient or the health care system level—are partly to blame. Further research is needed to better understand this disparity.

Several limitations should be considered in the interpretation of these findings. First, the administration of CPR was defined based on ICD-9 codes, which have not been validated for this use in the Medicare dataset. It is possible that different hospitals coded CPR differently; thus, the sensitivity and specificity of this definition may have varied between sites. Second, race was categorized only as black, white, or other, because further designations in Medicare data may not be accurate. Given the importance of racial differences in CPR rates and survival, information regarding other racial/ethnic groups would have added significantly to these findings. Third, given the nature of the dataset, there were multiple unmeasured potential confounders, including severity and type of underlying illness, initial rhythm during cardiac arrest, location of the patient in the hospital during cardiac arrest, time of day of the cardiac arrest, and time to defibrillation. Finally, survival to hospital discharge may not be the most clinically relevant outcome, as many patients may suffer significant neurologic impairment after CPR. Longer-term outcomes were not evaluated.

Applications for Clinical Practice

This study provides useful information about rates of survival following CPR that may be used by older patients and their physicians when making decisions about resuscitation preferences in the hospital. Further work is needed to understand the association between race, incidence of CPR, and post-CPR survival.

—Review by Yael Schenker, MD

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