Cardiopulmonary Resuscitation Outcomes in Hospitalized Community-Dwelling Individuals and Nursing Home Residents Based on Activities of Daily Living

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OBJECTIVES: To determine whether poor functional status is associated with worse outcomes after attempted cardiopulmonary resuscitation (CPR).

DESIGN: Retrospective study of individuals who experienced cardiac arrest stratified according to dependence in activities of daily living (ADLs) and residential status (nursing home (NH) or community dwelling).

SETTING: Two hundred thirty-five hospitals throughout North America.

PARTICIPANTS: Adult inpatients aged 65 and older who had experienced a cardiac arrest as reported to the Get with the Guidelines—Resuscitation registry between 2000 and 2008.

MEASUREMENTS: Primary outcomes were return of spontaneous circulation (ROSC) and survival to discharge.

RESULTS: Twenty-six thousand three hundred twenty-nine individuals who experienced cardiac arrest met inclusion criteria. NH residents dependent in ADLs had a lower odds than community-dwelling independent participants of achieving ROSC (odds ratio (OR) = 0.73, 95% confidence interval (CI) = 0.63–0.85), whereas participants dependent in ADLs from either residential setting had lower odds of survival (community-dwelling: OR = 0.76, 95% CI = 0.63–0.92; NH: OR = 0.79, 95% CI = 0.64–0.96) after adjusting for participant and arrest characteristics. Duration of resuscitation and doses of epinephrine or vasopressin were similar between groups and had no significant effect on ROSC or survival, although participants dependent in ADLs were more likely to have a do-not-resuscitate (DNR) order placed after ROSC. Overall, median time to signing a DNR order after resuscitation was 10 hours (interquartile range 2–70).

CONCLUSION: Functional and residential status are important predictors of survival after in-hospital cardiac arrest. Contrary to the hypothesis but reassuring from a quality-of-care perspective, less-aggressive attempts at resuscitation do not appear to contribute to poorer outcomes in individuals dependent in ADL, regardless of residential status. **J Am Geriatr Soc 61:34–39, 2013.**

Key words: CPR outcomes; functional status; nursing home

Knowledge of the likelihood of survival after cardiac arrest is an important component of effective advance care planning discussions about the future use of cardiopulmonary resuscitation (CPR),[1,2] but clinicians lack sufficient understanding of the predictors of survival after CPR to assist in such discussions. Studies have suggested that age is usually not an adequate criterion to predict survival,[3] and many elderly adults are willing to receive CPR.[4–6]

Although age is an inadequate predictor, there is limited evidence that functional status may be a predictor of poor CPR survival; for example, individuals who have had a stroke are much less likely to survive CPR than others.[7,8] Although functional status is a predictor of outcomes,[9–13] the relationship between functional status and outcomes after in-hospital cardiac arrest remains unclear.

It was hypothesized that poorer functional status would correlate with worse outcomes after attempted CPR in the hospital. Because more than half of nursing home

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(NH) residents have significant impairments in activities of daily living (ADLs),[14] it was theorized that this relationship would be most profound in NH residents. Furthermore, it was suspected that less-aggressive resuscitation efforts would contribute to this result, at least in part.

METHODS

A retrospective study of individuals who had a cardiac arrest reported to the Get with the Guidelines—Resuscitation (GWTG-R) registry (formerly the National Registry of Cardiopulmonary Resuscitation) was conducted from January 2000 to February 2008. The GWTG-R is an American Heart Association–sponsored, prospective, multisite, observational registry of in-hospital cardiac arrest that has been previously described.[15] Subjects were stratified into four groups according to functional status (independent or dependent in ADLs) and residential status (NH or community dwelling) based on a priori possibility of an interaction. Individuals transferred from other acute and rehabilitation hospitals were assumed to be community dwelling.

Data from the prearrest Cerebral Performance Category (CPC) scale were used to determine prearrest functional status.[16] The CPC was originally developed to assess postarrest neurological outcomes but was used to determine functional status on admission as well within GWTG-R. Subjects were categorized into five groups: good cerebral performance, moderate cerebral disability, severe cerebral disability, coma or vegetative state, and brain death. Subjects were considered to be independent in ADLs if their CPC on admission was 1 or 2 and dependent in ADLs if their CPC on admission was 3 or higher. Despite no prior validation in this context, this dichotomization was justified given the clear definitions of the categories. Individuals with an admission CPC of 4 or 5 were excluded in the primary analysis so that the study sample was more typical of clinical practice, although a sensitivity analysis including these individuals was performed.

Only the first cardiac arrest for each subject was included in the analysis (Figure 1). Only admitted inpatients with an arrest occurring in an intensive care unit, step-down unit, or general inpatient bed were included. Individuals were excluded if CPR was limited or suspended based on an advance directive or family wishes or if CPR was apparently inadvertently conducted despite the presence of a preexisting do-not-resuscitate (DNR) order. Individuals with missing preadmission CPC or missing information on prior residence were excluded as well.

Measures of the aggressiveness of resuscitation included CPR duration and total doses of epinephrine or vasopressin. CPR duration was defined as time from initiation of a hospital-wide response to end of resuscitation effort, resulting from return of spontaneous circulation (ROSC) or termination of efforts. The use of DNR orders after achieving ROSC and time to placing a DNR order after arrest were also analyzed.

Primary outcomes included ROSC after initial attempted resuscitation and survival to hospital discharge. Survival with good or no worse neurological function was included as a secondary outcome.

Bivariate analyses were performed using two-sided Student *t*-tests for normally distributed data and the Mann–Whitney test for skewed data. Multivariate logistic regressions were performed to adjust for potential confounders, which included subject age, sex, race, illness category, comorbidities,[17] evening or weekend arrest,[18] intensive care unit location (including cardiac care unit), telemetry monitoring, whether the arrest was witnessed, and initial rhythm. To assess whether the aggressiveness of the resuscitation mediated the effects of functional and residential status, a secondary regression was performed accounting for arrest duration and total doses of epinephrine or vasopressin for both primary outcomes. All data were analyzed using Stata version 11.0 (Stata Corp., College Station, TX). To account for potential correlation within hospitals, standard errors of parameter estimates were calculated using the Huber–White estimator[19,20] by clustering on hospital.

The University of Chicago institutional review board determined that this research was exempt from human subjects protection review.

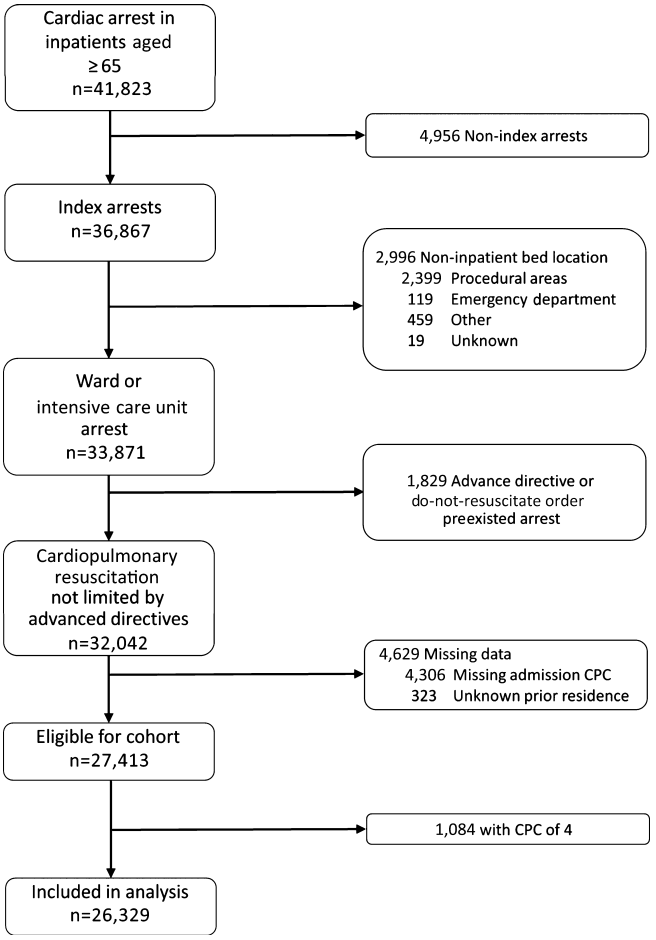

Figure 1. Identification of study subject population from the Get with the Guidelines—Resuscitation registry. CPC = Cerebral Performance Category.

RESULTS

Twenty-six thousand three hundred twenty-nine individuals who experienced a cardiac arrest from 235 hospitals met inclusion criteria (Figure 1). Seventy-eight percent of subjects were community-dwelling individuals independent in ADLs; 11% were from NHs. There were significant

differences between the groups for most of the baseline demographic and arrest characteristics (Table 1).

In bivariate analysis, community-dwelling individuals independent in ADLs were more likely to achieve ROSC (52%) than community-dwelling individuals dependent in ADLs (49%, $P = .005$) and NH residents independent (50%, $P = .04$) and dependent (43%, $P < .001$) in ADLs (Figure 2). After adjusting for potential confounders, only NH residents dependent in ADLs remained significantly less likely to achieve ROSC (odds ratio = 0.79, 95% confidence interval = 0.70–0.89) (Table 2).

Community-dwelling subjects independent in ADLs had the highest survival to discharge (18%), community-dwelling subjects dependent in ADLs (11%) and NH residents independent in ADLs (13%) had lower survival (Figure 2), and NH residents dependent in ADLs had the lowest survival (9%). In the adjusted analysis, subjects dependent in ADLs had lower survival, regardless of residential status (Table 2).

The secondary outcome of survival to discharge with good (CPC 1 or 2)[21] or no-worse neurological outcome had a similar relationship in bivariate analysis. Of community-dwelling subjects independent in ADLs, 15% survived with good or no-worse neurological outcome, compared with 10% of community-dwelling subjects dependent in ADLs ($P < .001$), 11% of NH residents independent in ADLs ($P < .001$), and 8% of NH residents dependent in ADLs ($P < .001$).

Subjects in all groups received similar aggressiveness of resuscitation attempts (Table 2), and adding these variables into the model did not affect the results (Table 3). The implementation of DNR orders after ROSC was less common in community-dwelling subjects independent in ADLs (48%) than in community-dwelling subjects dependent in ADLs (56%, $P < .001$), NH residents independent in ADLs (52%, $P = .006$), and NH residents dependent in ADLs (52%, $P = .02$). Overall, median time order from the initiation of resuscitation to implementation of DNR

Table 1. Descriptive Statistics of Adult Hospitalized Individuals Experiencing Cardiac Arrest in the Get with the Guidelines–Resuscitation from January 2001 to February 2008, Stratified According to Residential and Functional Status

	Community		Nursing Home			
Characteristic	Independent, n = 20,532 (78.0%)	Dependent, n = 2,952 (11.2%)	Independent, n = 1,546 (5.9%)	Dependent, n = 1,299 (4.9%)	*P*-Value	All, N = 26,329
Age, median (interquartile range)	76 (71–82)	78 (72–84)	79 (73–85)	80 (74–86)	<.001	77 (71–82)
Male	11,847 (57.7)	1,634 (55.4)	692 (44.8)	649 (50.0)	<.001	14,822 (56.3)
Race, n (%)						
White	15,803 (77.0)	1,949 (66.0)	1,112 (71.9)	789 (60.7)	<.001	19,653 (74.6)
Black	2,978 (14.5)	700 (23.7)	341 (22.1)	420 (32.3)	<.001	4,439 (16.9)
Other	1,751 (8.5)	303 (10.3)	93 (6.0)	90 (6.9)	<.001	2,237 (8.5)
Intensive care unit of cardiac care unit arrest, n (%)	10,918 (53.2)	1,535 (52.0)	688 (44.5)	597 (46.0)	<.001	13,738 (52.2)
Evening or weekend, n (%)	3,060 (14.9)	429 (14.5)	241 (15.6)	189 (14.5)	.82	3,919 (14.9)
Monitored, n (%)	16,694 (81.3)	2,301 (77.9)	1,182 (76.5)	952 (73.3)	<.001	21,129 (80.2)
Witnessed, n (%)	15,861 (77.3)	2,262 (76.6)	1,162 (75.2)	908 (69.9)	<.001	20,193 (76.7)
Illness category, n (%)						
Medical–cardiac	1,339 (6.5)	884 (29.9)	454 (29.4)	324 (24.9)	<.001	3,001 (11.4)
Medical–noncardiac	7,893 (38.4)	1,635 (55.4)	915 (59.2)	878 (67.6)	<.001	11,321 (43.0)
Surgical–cardiac	2,147 (10.5)	109 (3.7)	26 (1.7)	8 (0.6)	<.001	2,290 (8.7)
Surgical–noncardiac	2,910 (14.2)	268 (9.1)	146 (9.4)	82 (6.3)	<.001	3,406 (12.9)
Other	235 (1.1)	54 (1.8)	4 (0.3)	7 (0.5)	<.001	300 (1.1)
Preexisting condition						
Arrhythmia	8,104 (39.5)	1,165 (39.5)	556 (36.0)	476 (36.6)	.02	10,301 (39.1)
Congestive heart failure	7,620 (37.1)	1,039 (35.2)	650 (42.0)	470 (36.2)	<.001	9,779 (37.1)
Diabetes mellitus	6,444 (31.4)	949 (32.1)	609 (39.4)	451 (34.7)	<.001	8,453 (32.1)
Hepatic insufficiency	1,014 (4.9)	187 (6.3)	73 (4.7)	73 (5.6)	.01	1,347 (5.1)
Metastatic cancer	2,706 (13.2)	322 (10.9)	159 (10.3)	105 (8.1)	<.001	3,292 (12.5)
Renal insufficiency	6,939 (33.8)	1,113 (37.7)	579 (37.5)	526 (40.5)	<.001	9,157 (34.8)
Myocardial ischemia or infarction	7,311 (35.6)	823 (27.9)	409 (26.5)	277 (21.3)	<.001	8,820 (33.5)
Pneumonia	2,796 (13.6)	617 (20.9)	325 (21.0)	388 (29.9)	<.001	4,126 (15.7)
Septicemia	2,539 (12.4)	587 (19.9)	33 (2.1)	401 (30.9)	<.001	3,560 (13.5)
Initial rhythm						
Asystole	7,585 (36.9)	1,188 (40.2)	667 (43.1)	602 (46.3)	<.001	10,042 (38.1)
Pulseless electrical activity	7,546 (36.8)	1,138 (38.6)	534 (34.5)	461 (35.5)	<.001	9,679 (36.8)
Ventricular fibrillation or pulseless ventricular tachycardia	4,315 (21.0)	457 (15.5)	261 (16.9)	159 (12.2)	<.001	5,192 (19.7)

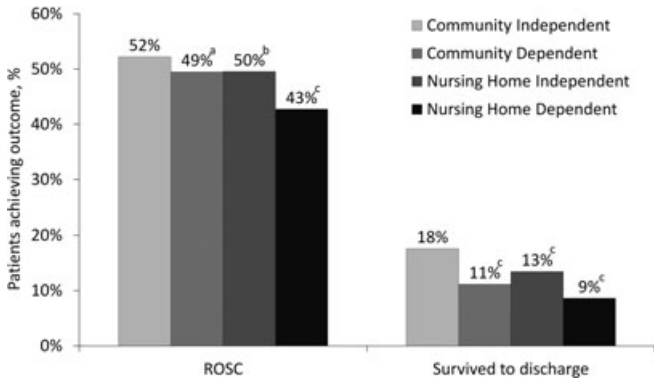

Figure 2. Return of spontaneous circulation and survival to discharge, unadjusted, stratified according to residential and functional status. All comparisons are with community-dwelling subjects independent in activities of daily living. $P^a = .005$, $P^b = .04$, $P^c < .001$.

was 10 hours (interquartile range 2–72 hours), with no significant differences between groups.

Individuals who were excluded on the basis of a prearrest CPC of 4 or 5 had a distribution of residential status similar to that of those who were included (11% from NH vs 13% from NH, $P = .07$). When the analysis was repeated and included these individuals, the results were similar (data not shown). Furthermore, the demographics of those excluded because of missing prearrest CPC were similar to the demographics of those included in the analysis (data not shown).

DISCUSSION

Functional and residential status are important predictors of survival after in-hospital cardiac arrest. NH residents dependent in ADLs are less likely to achieve ROSC, and all individuals dependent in ADLs, regardless of residential status, are less likely to survive to discharge. Contrary to the hypothesis but reassuring from a quality-of-care perspective, less-aggressive attempts at resuscitation do not appear to mediate poorer outcomes in individuals dependent in ADLs, regardless of residential status, although the relationship between aggressive resuscitation and other factors may have confounded the outcomes.[22] There were slight but statistically significant differences in the use of DNR orders between community-dwelling subjects independent in ADLs and those dependent in ADLs and all NH residents regardless of functional status, although these differences were unlikely to have accounted for the marked differences in survival.

It is not surprising that individuals who are dependent in ADLs, particularly NH residents, have worse outcomes, because functional status is an important predictor of mortality in hospitalized individuals,[9–13] but it is unclear whether knowledge of this information would affect advance care planning regarding CPR. Perhaps the most striking finding is that DNR orders are implemented in half of all individuals relatively rapidly after arrest, generally approximately 10 hours later, regardless of residential or functional status.

The fact that the GWTG-R may not be representative of all in-hospital cardiac arrests limited this study. The GWTG-R is a convenience sample self-reported from volunteer hospitals that may have a greater interest in improving resuscitation outcomes than other hospitals, but approximately 10% of all hospitals and 15% of those with more than 500 beds contribute to the registry, and the data and past GWTG-R data appear to correspond to national data collected from Medicare.[23] In addition, the reliability and validity of prearrest CPC, a measure developed primarily to assess postresuscitation neurological outcomes, as a proxy for dependence in ADLs is unknown. Functional status is a predictor of survival to discharge independent of underlying medical condition, confirming previous findings that functional status is a predictor of in-hospital mortality independent of underlying severity of illness.[10] Because the GWTG-R does not specifically collect information on prearrest functional status, and prearrest CPC was used to infer functional status, it was not possible to determine to what extent cognitive function, and in particular advanced dementia, explain some of the findings. Declines in cognitive function may independently contribute to mortality distinct from compromises in physical functioning.[9,24] Almost half of all NH residents have dementia,[14] and individuals with more-advanced forms of dementia are dependent in ADLs.

Table 2. Aggressiveness of Resuscitation and Do-Not-Resuscitate (DNR) Orders After Arrest According to Residential and Functional Status

	Community			Nursing Home			
Resuscitation	Independent	Dependent	*P*-Value[a]	Independent	*P*-Value[a]	Dependent	*P*-Value[a]
Duration of resuscitation, median (IQR)	16 (9–26)	15 (9–24)	<0.001	15 (10–24)	0.01	16 (10–24)	0.06
Doses of epinephrine or vasopressin, n (IQR)	3 (1–4)	3 (1–4)	0.42	3 (1–4)	0.97	3 (1–4)	0.50
Shocks for ventricular fibrillation or pulseless ventricular tachycardia, n (IQR)	2 (1–4)	2 (1–4)	0.14	2 (1–4)	0.28	2 (1–4)	0.52
Made DNR order after ROSC, n (%)	5,504 (47.7%)	970 (56.0%)	<0.001	486 (52.4%)	0.006	376 (52.2%)	0.02
Time to DNR order after ROSC, (IQR)	10 (2–70)	15 (2–86)	0.22	6 (1–59)	0.07	7 (1–71)	0.16

[a]All comparisons are with community-dwelling subjects independent in activities of daily.
IQR = interquartile range; ROSC = return of spontaneous circulation.

Table 3. Adjusted Analysis for Return of Spontaneous Circulation (ROSC) and Survival to Discharge According to Residential and Functional Status

	Community Dwelling	Nursing Home	
	Dependent	Independent	Dependent
Outcome	Odds Ratio (95% Confidence Interval)		
ROSC			
Main model[a]	0.97 (0.87–1.08)	0.96 (0.85–1.08)	0.79 (0.70–0.89)
Model + aggressiveness[b]	0.94 (0.85–1.05)	0.92 (0.82–1.04)	0.73 (0.63–0.85)
Survived to discharge			
Main model[a]	0.76 (0.63–0.92)	0.95 (0.81–1.10)	0.79 (0.64–0.96)
Model + aggressiveness[b]	0.72 (0.60–0.86)	0.94 (0.77–1.14)	0.77 (0.62–0.97)

All comparisons are with community-dwelling subjects independent in activities of daily.

[a]Multiple logistic regression adjusted for age, sex, race and Hispanic ethnicity, intensive care unit location, evening or weekend timing, monitored, witnessed, illness category, arrhythmia, baseline depression, central nervous system function, congestive heart failure, diabetes mellitus, hepatic insufficiency, metastatic cancer, renal insufficiency, myocardial ischemia or infarction, pneumonia, septicemia, hospice, and initial rhythm.

[b]Aggressiveness variables include event duration and number of doses of epinephrine or vasopressin.

Nevertheless, these findings demonstrate that functional status and NH residence are important predictors of resuscitation outcomes. Although these findings are statistically significant, further research is needed to determine their clinical significance for individuals engaged in advance care planning.

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