Out-of-Hospital Cardiac Arrest: Racial Differences in Outcome in Seattle

ABSTRACT

Objectives. Out-of-hospital sudden cardiac arrest is a key area in which to study the dual problem of the poorer health status of minority populations and their poorer access to the health care system. We proposed to examine the relationship between race (Black/White) and survival.

Methods. We determined the incidence and outcome of cardiac arrests in Seattle for which medical assistance was requested.

Results. Over a 26-month period, the age-adjusted incidence of out-of-hospital cardiac arrest was twice as great in Blacks than in Whites (3.4 vs 1.6 per 1000 aged 20 and over). The initial resuscitation rate was markedly poorer in the Black victims (17.1% vs 40.7%), and rates of survival to hospital discharge were also lower in Blacks (9.4% vs 17.1%). Both effective initial resuscitation and survival were significantly related to White race following adjustment for other covariates.

Conclusion. The differences in outcomes were not fully explained by features of the collapse or relevant service factors. Possible explanations include delays in instituting therapy, less bystander-initiated cardiopulmonary resuscitation, poorer levels of health, and differences in the underlying cardiac disorders. (*Am J Public Health.* 1993;83:955–959)

Martin R. Cowie, MRCP, Carol E. Fahrenbruch, MSPH, Leonard A. Cobb, MD, and Alfred P. Hallstrom, PhD

Introduction

Out-of-hospital sudden cardiac arrest has been identified as a key area in which to study the dual problem of the poorer health status of minority populations and their poorer access to the health care system.[1] These issues not only have troubled politicians[2] but have also become of increasing concern to health professionals.[3]

The purpose of this report is to describe the racial differences in the outcome of sudden cardiac arrest occurring in the area served by the Seattle Fire Department's emergency medical services division, and to analyze these differences in terms of service-related and demographic factors known to influence resuscitation and survival. We are unaware of previous studies addressing this issue. Since 1970, the Seattle emergency medical services program has provided rapid response to out-of-hospital medical emergencies, including cardiac arrest,[4,5] and has enhanced public awareness of cardiopulmonary resuscitation (CPR) through its community training program.[6]

Methods

From routine incident reports completed by paramedics, all cases of out-of-hospital cardiac arrest were identified for whom the Seattle Fire Department's assistance was requested from May 30, 1984, through July 31, 1986. The Seattle Fire Department is the sole agency responsible for delivering out-of-hospital advanced life support in Seattle, a city of approximately 500 000 population. Victims with arrests due to trauma, drug overdose, or other noncardiac conditions such as massive hemorrhage were excluded from analysis. Only victims aged 20 years or older were considered. The characteristics of the Seattle emergency medical services system have been described previously.[4–6]

Data extracted from the incident reports included the age, race, and gender of the victim; the victim's initial cardiac rhythm; treatments provided; whether the arrest was witnessed; and whether CPR was provided prior to the arrival of the emergency services team. Response times of the fire department units were obtained from the dispatch center recordings and verified by individual case review for a separate study.[4] For patients who were initially resuscitated, hospital records were reviewed to determine the patient's status at hospital discharge. Patients who were not able to live independently were classified as having major neurologic disability.

Factors known to influence the outcome of resuscitation[6] were selected for analysis in victims who were in arrest when the emergency team arrived at the scene of collapse and who received paramedic treatment. Factors included the presence of ventricular fibrillation, witnessed collapse, prompt (bystander) initiation of CPR, emergency team response times (including early application of defibrillation), younger age, and location of collapse (home vs away from home).

The authors are with the Departments of Medicine and Biostatistics at the University of Washington and the Harborview Medical Center in Seattle, Washington.

Requests for reprints should be sent to Leonard A. Cobb, MD, Division of Cardiology, ZA-35, Harborview Medical Center, 325 Ninth Ave, Seattle, WA 98104.

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TABLE 1—Outcomes by Race for 977 Victims of Out-of-Hospital Sudden Cardiac Arrest, on Emergency Medical Services Arrival

	Whites, % (No.) (n = 860)	Blacks, % (No.) (n = 117)	P[a]	Risk	95% Confidence Interval
Resuscitated and admitted to hospital	40.7 (350/860)	17.1 (20/117)	<.0001	3.48	2.08, 5.82
Age <62	44.5 (101/227)	18.9 (10/53)	<.002		
Age >61	39.3 (249/633)	15.6 (10/64)	<.0004		
Hospital mortality once admitted	58.0 (203/350)	45.0 (9/20)	>.80		
Age <62	47.5 (48/101)	50.0 (5/10)	>.99		
Age >61	62.2 (155/249)	40.0 (4/10)	>.27		
Survival to hospital discharge	17.1 (147/860)	9.4 (11/117)	<.03	2.15	1.11, 4.17
Age <62	23.3 (53/227)	9.4 (5/53)	<.04		
Age >61	14.8 (94/633)	9.4 (6/64)	>.31		
Major neurologic disability[b]	1.7 (15/860)	2.6 (3/117)	>.80		
Age <62	1.8 (4/227)	1.9 (1/53)	>.99		
Age >61	1.7 (11/633)	3.1 (2/64)	>.76		
Survival without major neurologic disability[b]	15.3 (132/860)	6.8 (8/117)	<.009	2.75	1.29, 5.87
Age <62	21.6 (49/277)	7.5 (4/53)	<.04		
Age >61	13.1 (83/633)	6.2 (4/64)	>.30		

[a]Overall *P* values, risks, and 95% confidence intervals are based on Mantel-Haenszel statistic from combining the age-specific observations.
[b]At time of hospital discharge.

TABLE 2—Characteristics by Race for 977 Victims of Out-of-Hospital Sudden Cardiac Arrest, on Emergency Medical Services Arrival

	Whites (n = 860)	Blacks (n = 117)	P
Initial rhythm state			
Ventricular fibrillation, %	49.1 (422/860)	40.2 (47/117)	<.09
Asystole, %	28.4 (244/860)	37.6 (44/117)	
Electromechanical dissociation, %	21.0 (181/860)	22.2 (26/117)	
Ventricular tachycardia, %	1.5 (13/860)	0	
Mean age, y (SD)	68.2 (13.8)	61.9 (16.8)	<.001
Males, %	69.8 (600/860)	67.5 (79/117)	>.69
Bystander CPR, %	31.7 (271/855)	18.1 (21/116)	<.003
Witnessed collapse, %	60.7 (494/814)	52.7 (58/110)	<.12
Response time of first arriving unit (min ± SD)	3.4 (1.3)	3.4 (1.2)	>.71
Response time of first defibrillator-equipped unit (min ± SD)	4.5 (2.4)	4.7 (2.2)	>.36

Differences of discrete variables were tested by Fisher's Exact Test or χ^2 with Yate's correction; continuous variables were tested by the *t* test or the Mann-Whitney rank sum nonparametric statistic. Racial differences in outcome variables stratified by age (20 to 61; 62 and older) were tested with the Mantel-Haenszel χ^2 statistic for combining two-by-two tables. The significance of race in the multivariate model was assessed by stepwise logistic regression after adjusting for the effects of covariates known to affect outcomes. Two-tailed tests of significance are reported.

Results

During the 26 months of this case series, fire department personnel responded to 1332 victims (1087 Whites, 137 Blacks, and 108 of other ethnic groups or unknown race) of out-of-hospital cardiac arrest aged 20 or older and of presumed cardiac etiology. Analysis was limited to the Whites and Blacks (n = 1224) because of the small number and varied ethnic background of the other victims. The ratio of Whites to Blacks in these cases with cardiac arrest was 7.9:1, compared with 10.8:1 in the Seattle population aged 20 and over.[8] The annual incidence rates for these cases of cardiac arrest per 1000 population aged 20 and over were 1.6 for White and 2.1 for Black victims. However, because the Black population was younger, the Black incidence rate was age adjusted to the age structure of the White population for an adjusted rate of 3.4 per thousand ($P < .001$, Whites vs Blacks). The overall survival rates for Blacks and Whites, respectively, were 10.2% (14/137) and 16.7% (182/1087) ($P < .07$); the proportions discharged without major neurologic disability were 8% (11/137) and 15.2% (165/1087) ($P < .04$).

Treated Cardiac Arrests

Of the 1224 patients, resuscitative efforts were ceased for 129 White and 12 Black victims because of rigor mortis or assessment by other health care professionals not to resuscitate. Thus, 1083 resuscitatable patients received advanced life support from fire department paramedics. Of these, 977 patients were pulseless and unconscious when fire department personnel arrived on the scene and 106 developed cardiac arrest after the emergency team arrived. The ratios of Whites to Blacks in the latter two groups were 7.4 and 12.3, respectively ($P > .20$). Tables 1 to 6 all show data restricted to patients who were found in cardiac arrest when first examined.

Table 1 shows the outcomes for these patients according to racial group and within the two age strata. Although we observed a significantly lower rate of initial resuscitation within the Black population (17.1% vs 40.7%, $P < .0001$), the groups fared somewhat equally once they were admitted to the hospital after spontaneous circulation was restored. Overall, the survival rate was lower in Blacks (9.4% vs 17.1%, $P < .03$). The proportion who survived without major neurologic disability was 15.3% for Whites and 6.8% in Blacks ($P < .009$).

Analysis by race of variables known to be predictive of outcome (Table 2) showed that Black victims were younger than the White ones ($P < .001$), which, other factors being equal, would tend to favor the survival of the Black victims. Neither the proportion with witnessed collapse nor the emergency team response times were significantly different, although witnessed arrest tended to be less

frequent in Black victims. Black victims were less likely to have had CPR initiated by a bystander prior to the arrival of the fire department personnel (18.1% vs 31.7%, $P < .003$). The proportion of Black victims found in ventricular fibrillation tended to be lower than that observed in White victims (40.2% vs 49.1%, respectively) while asystole was the first recorded rhythm in a correspondingly higher proportion of Blacks (37.6% vs 28.4%). Pulseless electrical rhythm (electromechanical dissociation) was present in approximately equal proportions of Blacks and Whites (Table 2).

Following adjustment for known covariates, logistic regression analyses were conducted to examine the role of race in relation to initial resuscitation and survival. Covariates included age, gender, response time of the first emergency team unit, response time of the first defibrillator-equipped emergency team unit, response time of the advanced life support unit, whether the arrest was witnessed, whether a bystander performed CPR, and initial cardiac rhythm on emergency team arrival (ventricular fibrillation vs all others; asystole vs all others). For the logistic regression analysis, the 13 cases of ventricular tachycardia (all in Whites) were combined with the ventricular fibrillation cases. Of the 977 patients, 92.0% (109 Blacks and 790 Whites) had known values for all covariates and were used in these multivariate analyses (Tables 3 and 4). Race was a significant predictor of both initial successful resuscitation and survival without major neurologic disability. As shown in Tables 3 and 4, the odds ratio for White vs Black race was approximately 4 for resuscitation and more than 2.5 for hospital discharge without major neurologic disability. When the 13 patients with ventricular tachycardia were excluded from the logistic analyses, nearly identical odds ratios were estimated.

TABLE 3—Predictors of Successful Initial Resuscitation in 899 Victims of Out-of-Hospital Cardiac Arrest, on Emergency Medical Services Arrival: Logistic Regression Analysis[a]

Covariate	Odds Ratio	95% Confidence Interval	P
Initial cardiac rhythm (ventricular fibrillation/ ventricular tachycardia vs other)	3.82	2.49, 5.86	<.001
Witnessed arrest	2.75	1.92, 3.92	<.001
Initial cardiac rhythm (asystole vs others)	0.72	0.43, 1.2	>.20
Male gender	1.00	0.69, 1.44	>.92
Age[b]	0.99	0.97, 1.0	<.07
Response time of first emergency team unit[b]	0.91	0.78, 1.04	<.17
Response time of the first defibrillator-equipped unit[b]	0.95	0.88, 1.04	>.28
Response time of paramedic unit[b]	0.97	0.92, 1.01	<.17
Bystander CPR	1.08	0.77, 1.51	>.28
White vs Black race	4.05	2.25, 7.28	<.001

[a]The assessment of race was estimated after all other covariates were forced into the model.
[b]Age and response times were evaluated in 1-year and 1-minute increments, respectively.

TABLE 4—Predictors of Survival to Hospital Discharge without Major Neurologic Disability in 899 Victims of Out-of-Hospital Cardiac Arrest, on Emergency Medical Services Arrival: Logistic Regression Analysis[a]

Covariate	Odds Ratio	95% Confidence Interval	P
Initial cardiac rhythm (ventricular fibrillation/ ventricular tachycardia vs other)	3.06	1.59, 5.89	<.001
Witnessed arrest	3.55	1.98, 6.36	<.001
Initial cardiac rhythm (asystole vs others)	0.19	0.05, 0.69	<.02
Male gender	1.51	0.89, 2.57	<.13
Age[b]	0.98	0.96, 1.00	<.01
Response time of first emergency team unit[b]	0.80	0.66, 0.97	<.03
Response time of the first defibrillator-equipped unit[b]	1.02	0.91, 1.14	>.77
Response time of paramedic unit[b]	0.98	0.92, 1.04	>.50
Bystander CPR	1.89	1.25, 2.85	<.003
White vs Black race	2.64	1.15, 6.07	<.02

[a]The assessment of race was estimated after all other covariates were forced into the model.
[b]Age was evaluated in one-year increments and response times in one-minute intervals respectively.

Treated Victims with Ventricular Fibrillation on Emergency Team Arrival

Table 5 shows outcomes by race, stratified by age, for the 422 White and 47 Black victims who had ventricular fibrillation when first examined. The initial resuscitation rate was significantly less for Black victims found in ventricular fibrillation (31.9% vs 60.4%, $P < .0008$). Although survival to hospital discharge and survival without neurologic morbidity tended to be lower in Blacks than in Whites (14.9% vs 26.3% for the latter outcome), these differences were not considered statistically significant ($P > .24$ and $< .09$, respectively).

Similar to the findings in the total series, the Black ventricular fibrillation patients were younger on average than the White patients (59.2 vs 66.5 years, $P < .002$), were slightly less likely to have had a witnessed arrest, and had comparable emergency team response times (Table 6). Automated external defibrillators were used by first responders in similar proportions of the two groups of ventricular fibrillation patients: 49.5% in Whites and 44.7% for Blacks. In ventricular fibrillation victims, bystander-initiated CPR was provided slightly less often to Blacks than to Whites (28.3% vs 40.1%; $P > .15$), and Black victims were more likely than White victims to have collapsed at home (76.6% vs 59.5%, $P < .04$). (The site of collapse was known only for the ventricular fibrillation victims.)

Again, logistic regression analyses were performed to examine whether the victims' race was independently predictive of successful initial resuscitation and survival without major neurologic disability. The covariates in the model were location of collapse (home vs away), patient age, gender, race, witnessed arrest, response time of the first arriving unit, response time of the advanced life support unit, and the response time of the unit whose personnel delivered the first shock. Three (White) patients who were not shocked could not be included in the mul-

TABLE 5—Outcomes by Race for 469 Victims of Out-of-Hospital Ventricular Fibrillation, on Emergency Medical Services Arrival

	Whites, % (No.) (n = 422)	Blacks, % (No.) (n = 47)	P[a]	Risk	95% Confidence Interval
Resuscitated and admitted to hospital	60.4 (255/422)	31.9 (15/47)	<.0008	3.10	1.60, 6.00
Age <62	55.6 (74/133)	33.3 (8/24)	<.05 FET[c]		
Age >61	62.6 (181/289)	30.4 (7/23)	<.005		
Hospital mortality once admitted	51.4 (131/255)	33.3 (5/15)	>.43		
Age <62	37.8 (28/74)	37.5 (3/8)	>.99		
Age >61	56.9 (103/181)	28.6 (2/7)	>.24		
Survival to hospital discharge	29.4 (124/422)	21.3 (10/47)	>.24		
Age <62	34.6 (46/133)	20.8 (5/24)	>.27		
Age >61	27.0 (78/289)	21.7 (5/23)	>.76		
Major neurologic disability at discharge[b]	3.1 (13/422)	6.4 (3/47)	>.42		
Age <62	3.0 (4/133)	4.2 (1/24)	>.56 FET[c]		
Age >61	3.1 (9/289)	8.7 (2/23)	>.42		
Survival without major neurologic disability[b]	26.3 (111/422)	14.9 (7/47)	<.09	2.21	0.94, 5.19
Age <62	31.6 (42/133)	16.7 (4/24)	>.22		
Age >61	23.9 (69/289)	13.0 (3/23)	>.35		

[a]Overall *P* values, risks, and 95% confidence intervals are based on Mantel-Haenszel statistic from combining the age-specific observations.
[b]At time of hospital discharge.
[c]FET = Fisher's Exact Test.

TABLE 6—Characteristics by Race for 469 Victims of Out-of-Hospital Ventricular Fibrillation, on Emergency Medical Services Arrival

	Whites (n = 422)	Blacks (n = 47)	P
Mean age, ± SD	66.5 ± 12.4	59.2 ± 16.5	<.002
Males, %	81.0 (342/422)	83.0 (39/47)	>.90
Bystander CPR, %	40.1 (169/421)	28.3 (13/46)	>.15
Witnessed collapse, %	77.8 (319/410)	68.1 (32/47)	>.18
Collapse at home, %	59.5 (251/422)	76.6 (36/47)	<.04
Patients who received initial shock from first responder's automated defibrillator, %	49.5 (208/420)	44.7 (21/47)	>.63
Response time of first arriving unit, average min ± SD	3.3 ± 1.3	3.3 ± 1.2	>.80
Response time of unit administering shock, average min ± SD	4.6 ± 2.4	4.8 ± 2.0	>.28

tivariate analysis. All covariates were known in 442 of the 469 patients, (46 Blacks and 396 Whites, or 94.2%). In the first multivariate analysis, following adjustment for the known covariates, the odds ratio for resuscitation and admission to hospital was 3.2 ($P < .001$, 95% confidence interval [CI] = 1.58, 6.44), favoring White over Black ventricular fibrillation victims. In a second multivariate analysis, survival to hospital discharge without neurologic morbidity had a nonsignificant odds ratio of 2.1 ($P < .10$, 95% CI = 0.84, 5.18), tending to favor Whites over Blacks.

Victims Who Developed Cardiac Arrest under Surveillance of Emergency Team Personnel

Of the 106 patients who developed cardiac arrest after arrival of the emergency services personnel, 98 were White and only 8 were Black. Resuscitation rates in this small group were similar but tended to favor the Blacks (87.5% vs 61.2%, $P > .20$). The rates of survival without neurologic disability were 33.7% for Whites and 37.5% in Blacks.

Discussion

In this case series of persons assessed by emergency service personnel because of out-of-hospital cardiac arrest, the age-adjusted annual incidence for Blacks was double that of Whites (3.4 vs 1.6 arrests per 1000 population aged 20 and over). The Black victims were younger and had significantly poorer initial resuscitation and survival rates. Although our observations could possibly be attributed in part to sampling variability related to the relatively small number of Blacks, we think it unlikely that this represents a major shortcoming of the study.

The poorer outcomes might be partially explained by the fact that, on arrival of the emergency team, a slightly lower proportion of the Black victims (40.2% vs 49.1%) were found in ventricular fibrillation, the rhythm that carries a much higher probability of survival than asystole or electromechanical dissociation. However, when considering only those victims found in ventricular fibrillation, the initial outcome of resuscitation was still much poorer in Black than in White victims. In the subset of patients with ventricular fibrillation, the racial difference in survival was less impressive, but the overall rate of survival without neurologic disability still favored Whites, albeit only marginally so from a statistical perspective.

Previous work has demonstrated features of cardiac arrest in this community that were associated with outcome,[5] but the Black-White difference is not explained completely by those variables. It is therefore likely that additional factors are at work to reduce the probability of successful resuscitation. The features of treating cardiac arrest that relate to outcome have been described in predominantly White populations, and it is possible that the relationships between these variables and outcome, particularly any underlying associations with health or behavior, may not be the same for diverse ethnic groups. Additionally, the illness behavior or "symptom response" of minority populations may differ from that of their cocitizens.[9,10] Although the numbers were small, proportionately more Blacks were in cardiac arrest when first examined compared with those who developed arrest while under paramedic surveillance. That might suggest hesitancy or delay among the Blacks before requesting aid. Unfortunately, we do not

have adequate data from interviews to estimate either the delays between collapse and request for assistance or the prevalence of symptoms prior to cardiac arrest.

We found no racially based differences in emergency team response times, in the proportion of cases who received advanced life support, or in outcome when paramedics witnessed the arrests. Hence, there were no indications that service factors might have been responsible for the differences in outcome according to race.

Socioeconomic differences among populations or population subgroups are known to be correlated with health status,[11–13] and most minority populations within the United States have a lower socioeconomic status than their White counterparts.[14] It may be that the poorer background level of health and the greater prevalence of concomitant pathology[1] within the Black victims of sudden cardiac arrest act to reduce the likelihood of successful resuscitation. There is evidence that Blacks with recognized coronary artery disease tend to have particularly severe disease.[15] Perhaps those who fall prey to sudden cardiac arrest have a more extensive degree of coronary artery disease or greater myocardial dysfunction, which thereby makes resuscitation less likely. Additionally, it is possible that a consideration of the underlying cardiac disorders—for example, noncoronary cardiomyopathies—might shed light on the lower rate of initial resuscitation.

What can be done to improve this situation? Some improvement might be realized by increasing the uptake of CPR instruction within the Black population. Minority populations are less knowledgeable with regard to CPR,[6] and the present study has shown that Black victims of out-of-hospital sudden death may be less likely to have CPR initiated by a bystander.

Again, there was no evidence here that service-related factors contributed to the racial difference in resuscitation. We suggest that the underlying socioeconomic and health status of the minority populations are factors likely to affect outcome from cardiac arrest, and that further studies to clarify and ultimately correct this relationship are appropriate. □

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