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The Impact of Ethnicity on Outcomes Following Coronary Artery Bypass Graft Surgery in the Veterans Health Administration

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OBJECTIVES We evaluated the effect of African American (AA) and Hispanic American (HA) ethnicity on mortality and complications following coronary artery bypass graft (CABG) surgery in the Veterans Health Administration (VHA).

BACKGROUND Few studies have examined the impact of ethnicity on outcomes following cardiovascular procedures.

METHODS This study included all 29,333 Caucasian, 2,570 AA, and 1,525 HA patients who underwent CABG surgery at any one of the 43 VHA cardiac surgery centers from January 1995 through March 2001. We evaluated the relationship between ethnicity (AA vs. Caucasian and HA vs. Caucasian) and 30-day mortality, 6-month mortality, and 30-day complications, adjusting for a wide array of demographic, cardiac, and noncardiac variables.

RESULTS After adjustment for baseline characteristics, AA and Caucasian patients had similar 30-day (AA/Caucasian odds ratio [OR] 1.07; 95% confidence interval [CI] 0.84 to 1.35; $p = 0.59$) and 6-month mortality risk (AA/Caucasian OR 1.10; 95% CI 0.91 to 1.34; $p = 0.31$). However, among patients with low surgical risk, AA ethnicity was associated with higher mortality (OR 1.52, CI 1.10 to 2.11, $p = 0.01$), and AA patients were more likely to experience complications following surgery (OR 1.28; 95% CI 1.14 to 1.45; $p < 0.01$). In contrast, HA patients had lower 30-day (HA/Caucasian OR 0.70; 95% CI 0.49 to 0.98; $p = 0.04$) and 6-month mortality risk (HA/Caucasian OR 0.66; 95% CI 0.50 to 0.88; $p < 0.01$) than Caucasian patients.

CONCLUSIONS Ethnicity does not appear to be a strong risk factor for adverse outcomes following CABG surgery in the VHA. Future studies are needed to determine why AA patients have more complications, but ethnicity should not affect the decision to offer the operation. (J Am Coll Cardiol 2002;40:1786–93) © 2002 by the American College of Cardiology Foundation

The influence of race on cardiovascular procedure use and outcomes has been an area of extensive investigation. Many studies have found that non-Caucasian race in general, and African American (AA) and Hispanic American (HA) ethnicity in particular, are associated with lower rates of cardiovascular procedure use, including cardiac catheterization, percutaneous coronary intervention (PCI), and coronary artery bypass graft (CABG) surgery (1–12). Factors such as differences in baseline clinical characteristics, disease severity, reluctance by AA patients to undergo invasive cardiac procedures, and overuse of procedures in Caucasians may explain some of the observed differences in cardiac procedure use (13–17).

The impact of ethnicity on outcomes following coronary revascularization is less clear. One potential concern is that if racial minorities are less likely to be referred for cardiac catheterization and coronary revascularization, then only those with particularly advanced disease or compelling indications may undergo these procedures, leading to worse outcomes. Several studies have reported worse survival for AA patients following CABG surgery (18–21), whereas other studies have reported similar survival between Caucasian and AA patients following the operation (22–25). To our knowledge, no previous studies have evaluated complication rates or examined post-CABG outcomes in HA patients.

The goal of this study was to compare 30-day mortality, 30-day complication rates, and 6-month mortality following CABG surgery for AA and HA patients in comparison to Caucasian patients in the Veterans Health Administration (VHA). This included an evaluation of the relationship between estimated preoperative risk of the patients and outcomes in order to determine whether differences in baseline risk were leading to differences in outcome. Our hypothesis was that outcomes would be equivalent across racial groups after controlling for differences in baseline clinical characteristics.

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METHODS

Study population. The study population was derived from the VHA Continuous Improvement in Cardiac Surgery

Abbreviations and Acronyms

AA	= African American
CABG	= coronary artery bypass graft
CI	= confidence interval
CICSP	= Continuous Improvement in Cardiac Surgery Program
HA	= Hispanic American
LVH	= left ventricular hypertrophy
OR	= odds ratio
PCI	= percutaneous coronary intervention
VA	= Veterans Affairs
VHA	= Veterans Health Administration

Program (CICSP) database. The CICSP has prospectively collected clinical data on all patients undergoing cardiac surgery in the VHA since 1987 (26,27). Trained clinical nurse reviewers located at each of the 43 Veterans Affairs (VA) cardiac surgical centers collect preoperative risk, surgical procedural, and outcome data (30-day complications and mortality) on all cardiac surgery patients. Patients were included in this study if they underwent CABG-only surgery (i.e., no valve surgery) at any of the VA cardiac surgical centers from January 1995 through March 2001, and were of Caucasian, AA, or HA race/ethnicity. Of 37,786 patients who underwent CABG-only surgery in the VHA during this period, race/ethnicity was missing in 1,616 patients (4.3%), and 2,742 patients (7.3%) were of other races/ethnicities, giving a final study population of 33,428 patients. The final study population was comprised of 29,333 Caucasian (87.7%), 2,570 AA (7.7%), and 1,525 HA patients (4.6%). The terms "race" and "ethnicity" are variably used in the literature to describe AA, HA, and Caucasian patients. For consistency, we use the term "ethnicity" throughout the rest of this paper.

Variables. The three outcome variables for this study were: 1) 30-day all-cause mortality, 2) 6-month all-cause mortality, and 3) 30-day complication rates. Mortality assessments were done using: 1) the VHA Beneficiary Identification and Record Locator System, shown to be comparable with the National Death Index for mortality assessment in a VA population (28); and 2) individual follow-up by CICSP personnel utilizing the VHA national computerized patient record system and individual patient/family telephone calls. Complications were assessed by chart review and individual follow-up by the CICSP nurse reviewers at each site. Complications included renal failure requiring dialysis, mediastinitis, respiratory complications (on a ventilator for ≥48 h), cardiac complications (repeat cardiopulmonary bypass or cardiac arrest requiring cardiopulmonary resuscitation), re-operation for bleeding, and neurologic complications (coma or stroke). Outcome assessment (both complications and mortality) is felt to be close to 100% complete in the VA CICSP database.

The primary predictor variable for this study was ethnicity (AA, HA, and Caucasian). A wide array of preoperative variables, including demographic, cardiac, and noncardiac factors, as well as intraoperative variables such as number and types of grafts used, were available for risk adjustment (Table 1). These variables included established risk variables for 30-day and 6-month mortality, and 30-day complications (26,27,29–31).

Statistical analyses. The objective of this study was to determine whether AA and/or HA patients are at differential risk for adverse outcomes compared with Caucasian patients following CABG surgery. Therefore, Caucasian ethnicity was the referent group for all analyses, and two comparisons were made: 1) AA versus Caucasian and 2) HA versus Caucasian. Baseline characteristics of the study population were compared between AA and Caucasian patients, and between HA and Caucasian patients, using *t* tests for continuous variables and chi-square tests for categorical variables.

30-DAY AND 6-MONTH MORTALITY. The unadjusted association between AA (vs. Caucasian) and HA (vs. Caucasian) ethnicity and both 30-day and 6-month mortality were evaluated using chi-square tests, and Kaplan-Meier curves were developed to compare unadjusted 6-month survival between ethnicity groups. Multiple linear regression models were then developed to assess the impact of AA and HA ethnicity on 30-day and 6-month mortality after adjusting for all of the variables listed in Table 1. Interactions between ethnicity and several risk factors shown to have different prevalence between ethnicities, including age, diabetes, and renal insufficiency, were added to the logistic regression models to determine their significance. Because ethnicity groups were not evenly distributed across sites, we adjusted for the proportion of AA and HA patients by site, which did not alter the results. Regression models were also developed using backward selection with the variables listed in Table 1 ($p < 0.10$ for entry; $p < 0.05$ to remain in model), and then adding the ethnicity variables to these selected models to assess their significance. The unselected and selected regression models yielded similar results, and the parameter estimates from the unselected models are reported in this paper.

For the six-month mortality outcome, secondary regression models were developed using Cox proportional hazards regression to model survival time. The results of the Cox regression analyses were similar to the logistic regression analyses and are not reported in this paper. We chose to report the logistic regression results for comparability to the 30-day mortality models. Furthermore, given the relatively low risk of death and lack of censoring in this study population (complete follow-up on all patients), Cox regression is not more efficient than logistic regression (32), and logistic regression allows reporting of odds ratios (ORs) that are easily interpretable.

Secondary analyses were undertaken to further evaluate the relationship between preoperative risk and ethnicity because previous studies have suggested that the impact of ethnicity on 30-day mortality following CABG surgery may

Table 1. Characteristics of Study Population

Variables	Caucasian (n = 29,333)	African American (n = 2,570)	p Value*	Hispanic American (n = 1,525)	p Value†
Demographic					
Age (mean, SD), yrs	63.6 (9.4)	62.2 (10.0)	< 0.01	63.8 (9.25)	0.51
Gender (% male)	98.9	98.9	0.91	99.5	0.03
Body surface area (mean, SD)	2.01 (0.192)	2.00 (0.194)	0.10	1.90 (0.179)	< 0.01
Cardiac					
Prior MI (%)	58.4	56.4	0.05	58.8	0.79
Prior PCI (%)	1.7	2.8	< 0.01	2.6	0.01
Prior heart surgery (%)	7.6	4.2	< 0.01	5.4	< 0.01
Preoperative IABP (%)	5.4	4.9	0.36	6.0	0.31
CCS angina class 3 or 4 (%)	77.5	80.5	< 0.01	72.8	< 0.01
NYHA class III or IV (%)	3.5	3.9	0.21	3.5	0.86
Ejection fraction			0.02		0.09
>0.55	48.9	45.4		45.8	
0.45–0.54	23.1	23.9		23.3	
0.35–0.44	16.5	18		18.6	
<0.34	11.5	12.7		12.4	
Three-vessel CAD (%)	71.8	73.3	0.11	75.9	< 0.01
ST-segment depression on preoperative ECG (%)	19.1	23.7	< 0.01	22.3	< 0.01
Preoperative diuretics (%)	23.9	27.4	< 0.01	22.0	0.10
Preoperative intravenous nitroglycerin (%)	14.9	12.9	< 0.01	15.9	0.30
Priority of surgery (%)			< 0.01		< 0.01
Elective	82.4	86.5		85.0	
Urgent	11.5	9.6		9.0	
Emergent	6.1	3.9		6.0	
IMA graft used (%)	82.4	82.8	0.67	84.4	0.04
Number of anastamoses (mean ± SD)	3.18 ± 0.97	3.10 ± 1.01	< 0.01	3.28 ± 0.94	< 0.01
Noncardiac					
Serum creatinine (mean, SD), mg/dl	1.22 (0.679)	1.43 (1.16)	< 0.01	1.28 (1.03)	0.03
PVD (%)	23.5	27.9	< 0.01	27.7	< 0.01
CVD (%)	21.5	19.8	0.05	17.9	< 0.01
Diabetes mellitus (%)	31.4	38.1	< 0.01	47.8	< 0.01
Current smoker (%)	31.6	34.9	< 0.01	21.2	< 0.01
COPD (%)	25.9	19.6	< 0.01	19.3	< 0.01
Hypertension (%)	82.6	90.0	0.01	86.8	0.30
Estimated preoperative mortality risk			0.35		0.26
Low (<1.6%)	33.3	32.9		33.3	
Medium (1.6%–3.2%)	33.0	34.4		34.8	
High (>3.2%)	33.7	32.7		31.9	

*Comparison between African-American and Caucasian cohorts; †comparison between Hispanic American and Caucasian cohorts.
CAD = coronary artery disease; CCS = Canadian Cardiovascular Society; COPD = chronic obstructive pulmonary disease; CVD = cerebrovascular disease; ECG = electrocardiogram; IABP = intra-aortic balloon pump; IMA = internal mammary artery; MI = myocardial infarction; NYHA = New York Heart Association; PCI = percutaneous coronary intervention; PVD = peripheral vascular disease.

be most prominent among lower risk patients (18,19). First, patients were classified into decile groupings based on their preoperative risk scores (obtained from the 30-day mortality logistic regression model with ethnicity excluded), and graphs of risk ratios for 30-day mortality for AA versus Caucasian and HA versus Caucasian ethnicity across preoperative risk deciles were made. Second, we tested the significance of ethnicity-by-risk interaction in the 30-day mortality logistic regression model. Finally, the overall estimated risk of 30-day mortality based on preoperative characteristics was compared across ethnicity groups, and comparisons of 30-day and 6-month mortality were made excluding the highest risk patients (those in the highest three deciles estimated preoperative risk). Higher versus lower risk was not defined a priori, but sensitivity analyses were undertaken altering the definition of high risk (i.e., the highest decile, 2 deciles, 3 deciles, 4 deciles, and 5 deciles) which did not significantly alter the results.

COMPLICATIONS. For the primary analyses, complications were dichotomized as one or more versus no complications within 30 days following surgery. Chi-square tests were used to assess the bivariate association between the ethnicity variables and complications. Multiple logistic regression models were then developed to assess the impact of AA and HA ethnicity on 30-day complications, adjusting for the variables listed in Table 1. Secondary analyses were performed evaluating each of the individual complications separately.

All statistical analyses were done using SAS version 8.02 (SAS Institute, Cary, North Carolina). Power calculations were done using PASS software 2000 (NCSS, Kaysville, Utah). We had 80% power to detect a 1% difference in

Table 2. Unadjusted Outcomes*

Variables	Caucasian	African American	p Value†	Hispanic American	p Value‡
30-day mortality	3.6	3.9	0.48	2.8	0.09
6-month mortality	5.8	6.3	0.27	4.5	0.04
30-day complications (one or more complications)	12.2	15.3	< 0.01	12.1	0.92
Complication subgroups					
Neurologic complications (coma or stroke)	2.3	2.9	0.06	2.8	0.24
Renal failure requiring dialysis	1.0	1.7	< 0.01	0.9	0.66
Mediastinitis	1.6	1.4	0.38	1.3	0.34
Respiratory complications (on ventilator ≥ 48 h)	6.7	8.4	< 0.01	7.1	0.57
Cardiac complications (repeat cardiopulmonary bypass or cardiac arrest requiring CPR)	2.8	3.1	0.35	2.3	0.22
Reoperation for bleeding	2.6	3.5	< 0.01	2.9	0.43

*Values are expressed as percentages except p values; †comparison between African American and Caucasian cohorts; ‡comparison between Hispanic-American and Caucasian cohorts.
CPR = cardiopulmonary resuscitation.

30-day mortality between AA and Caucasian patients, and 80% power to detect a 1.5% difference in 30-day mortality between HA and Caucasian patients. We had 85% power to detect a 1.5% difference in six-month mortality between AA and Caucasian patients, and 87% power to detect a 2% difference in six-month mortality between HA and Caucasian patients.

RESULTS

Baseline characteristics. Baseline characteristics of the study population are compared between AA, HA, and Caucasian patients in Table 1. Given the large study population, many baseline comparisons were statistically different at the $p < 0.05$ level (33). Therefore, baseline characteristics with relative differences of 10% or more between the cohorts are reported in the following text.

Compared with Caucasian patients, AA patients were more likely to have prior PCI, ST-segment depression on preoperative electrocardiogram, elevated serum creatinine, peripheral vascular disease, diabetes, to be current smokers, and to receive preoperative diuretics. Compared with Caucasian patients, HA patients were more likely to have prior PCI, ST-segment depression on preoperative electrocardiogram, peripheral vascular disease, and were 1.5 times more likely to have diabetes. Conversely, Caucasian patients were more likely than either AA or HA patients to have prior heart surgery, chronic obstructive pulmonary disease, and to be classified as having urgent or emergent surgery. Overall, there was no significant difference in the estimated preoperative mortality risk between AA and Caucasian patients ($p = 0.35$) or between HA and Caucasian patients ($p = 0.26$).

Unadjusted outcomes. There was no significant difference in unadjusted 30-day mortality (3.9% vs. 3.6%; $p = 0.48$), 6-month mortality (6.3% vs. 5.8%; $p = 0.27$), or 6-month survival (log-rank test p value = 0.44) between AA and Caucasian patients (Table 2, Fig. 1). However, AA patients were more likely to have one or more complications within 30 days following surgery (15.3% vs. 12.2%; $p < 0.01$). Specifically, AA patients were more likely to have renal failure requiring dialysis (1.7% vs. 1.0%; $p < 0.01$), respiratory complications (8.4% vs. 6.7%; $p < 0.01$), and reoperation for bleeding (3.5% vs. 2.6%; $p < 0.01$).

There was a trend toward lower 30-day mortality for HA patients versus Caucasian patients (2.8% vs. 3.6%; $p = 0.09$), and HA patients had significantly lower 6-month mortality (4.5% vs. 5.8%; $p = 0.04$) (Table 2). Hispanic American patients had significantly better six-month unadjusted survival than Caucasian patients (log-rank test p value = 0.04) (Fig. 1). The better survival for HA patients was evident immediately following surgery and persisted through the follow-up period. There was no significant difference in 30-day complications (12.1% vs. 12.2%; $p = 0.92$) between HA and Caucasian patients.

Risk-adjusted outcomes. In the regression models (Table 3), there were no significant differences in overall risk-adjusted 30-day (OR 1.07; 95% confidence interval [CI] 0.84 to 1.35; $p = 0.59$) or 6-month mortality (OR 1.10; 95% CI 0.91 to 1.34; $p = 0.31$) between AA and Caucasian patients. There was no significant interaction between AA ethnicity and age, diabetes, or serum creatinine in the regression models. However, AA patients were more likely to have one or more complications within 30 days after the operation (OR 1.28; 95% CI 1.14 to 1.45; $p < 0.01$), after adjustment for baseline characteristics.

Figure 2 demonstrates that among lower preoperative risk patients, AA ethnicity appears to be associated with higher mortality, and there was a significant interaction between ethnicity and risk deciles ($p = 0.02$). Excluding the highest risk patients, AA ethnicity was significantly associated with both higher 30-day (OR 1.52, CI 1.10 to 2.11, $p = 0.01$) and 6-month mortality (OR 1.45; CI 1.09 to 1.89; $p < 0.01$). Furthermore, among lower preoperative risk patients,

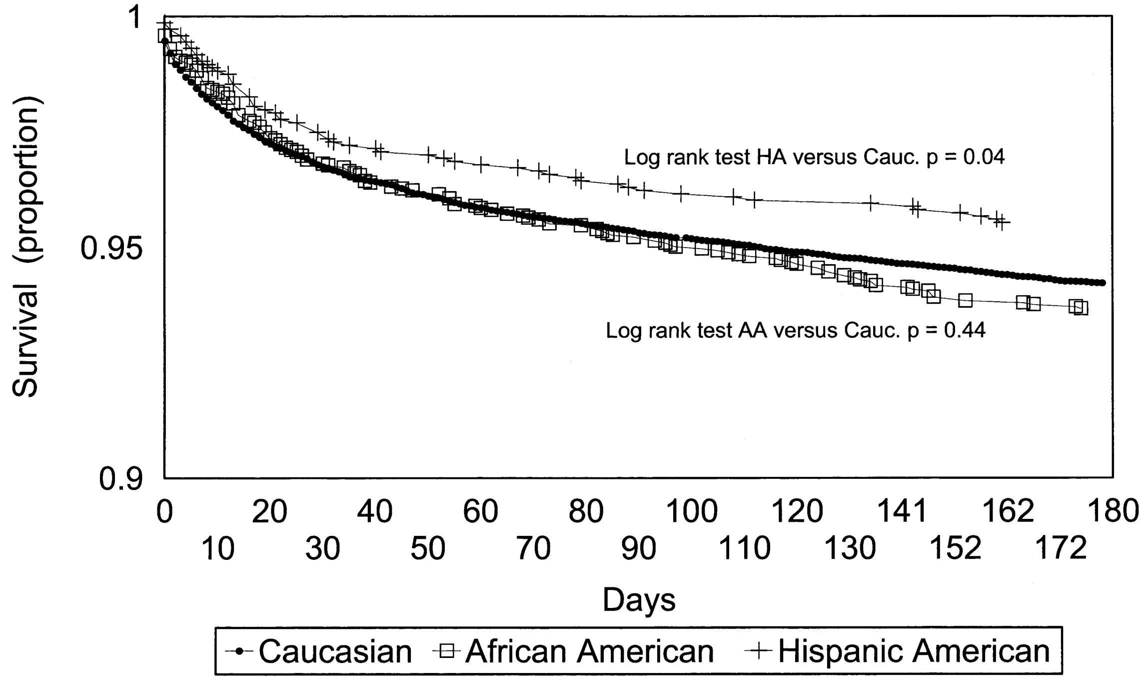

Figure 1. Six-month Kaplan-Meier survival curves for Caucasian (Cauc.), African American (AA), and Hispanic American (HA) cohorts.

AA patients had a one-third greater likelihood of having one or more complications than Caucasian patients (12.3% vs. 9%; $p < 0.01$). When we adjusted for the incidence of complications in the mortality prediction model, we found that AA ethnicity was no longer a significant predictor of mortality (OR 1.18, CI 0.83 to 1.67; $p = 0.36$). These findings suggest that increased complications among lower preoperative risk AA patients led to their higher mortality compared with low-risk Caucasian patients.

Following risk adjustment, HA patients had significantly lower 30-day (OR 0.70; 95% CI 0.49 to 0.98; $p = 0.04$) and 6-month mortality (OR 0.66; 95% CI 0.50 to 0.88; $p < 0.01$) than Caucasian patients (Table 3). There was no significant interaction between HA ethnicity and age, diabetes, or serum creatinine in the regression models. Adjusting for the proportion of HA patients at each site did not alter the results, suggesting that HA patients were not merely clustered at sites with good outcomes. Figure 3 suggests that the lower mortality found for HA versus Caucasian patients may be most prominent for patients with lower preoperative risk, but there was no significant interaction between ethnicity and risk deciles for this cohort ($p = 0.48$). Finally, there was no significant difference in risk-adjusted 30-day complication rates between HA and Caucasian patients (OR 0.96; 95% CI 0.81 to 1.14; $p = 0.67$).

Table 3. Multivariate Risk Models for 30-Day Mortality, 6-Month Mortality, and 30-Day Complications*

Variables	OR (CI)	p Value
30-day mortality		
Caucasian†	1.0	—
African American	1.07 (0.84–1.35)	0.59
Hispanic American	0.70 (0.49–0.98)	0.04
6-month mortality		
Caucasian†	1.0	—
African American	1.10 (0.91–1.34)	0.31
Hispanic American	0.66 (0.50–0.88)	< 0.01
30-day complications‡		
Caucasian†	1.0	—
African American	1.28 (1.14–1.45)	< 0.01
Hispanic American	0.96 (0.81–1.14)	0.67

*Adjusted for the demographic, cardiac, and noncardiac variables listed in Table 1; †Caucasian = referent group; ‡complications = one or more of the complications listed in Table 2.

CI = confidence interval; OR = odd ratio.

DISCUSSION

The objective of this study was to determine whether AA and/or HA patients were at increased risk for adverse outcomes compared with Caucasian patients following CABG surgery in the VHA. There were some significant differences in the baseline characteristics of the patients, but there was no overall difference in preoperative mortality risk between the ethnicity cohorts. AA and Caucasian patients had similar overall 30-day and 6-month mortality rates following CABG surgery. However, among patients who appeared to be at low risk before CABG surgery, AA ethnicity was associated with increased mortality. Furthermore, AA patients were more likely to have complications following the operation, including renal failure requiring dialysis, respiratory complications, and re-operation for bleeding. In contrast, HA patients had significantly lower 30-day and 6-month mortality than Caucasian patients, and there was no significant difference in complications rates between HA and Caucasian patients.

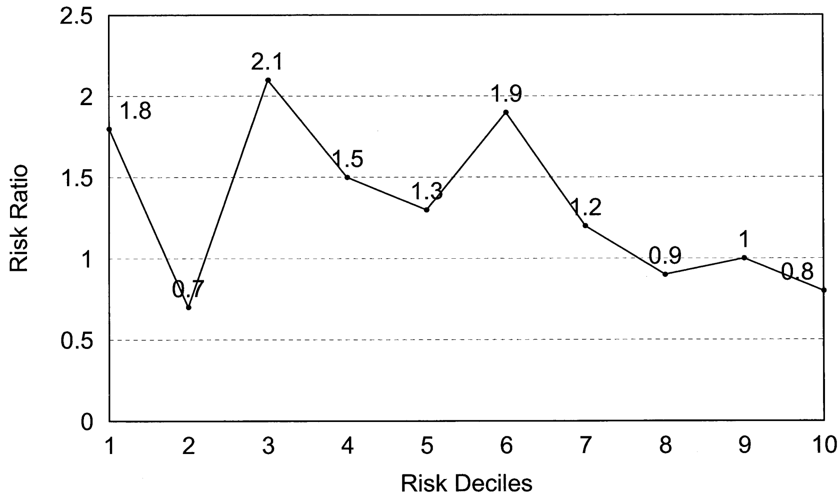

Figure 2. Risk ratios for 30-day mortality for African-American versus Caucasian patients across deciles of preoperative risk.

Previous studies evaluating the impact of AA ethnicity on mortality following CABG surgery have had mixed conclusions. Several studies have reported higher mortality for AA patients following the operation (18–21). Importantly, two of these studies found higher mortality for AA patients only among patients with lower preoperative risk (18,19). Other studies, including two conducted in veteran populations using administrative datasets, have suggested similar risk-adjusted survival for AA patients following CABG surgery (22–25). These studies did not specifically evaluate the relationship between preoperative risk groups and outcome. The results of our study may help explain the previous discrepant published studies. We found that overall mortality did not differ between AA and Caucasian patients following CABG surgery, consistent with the previous studies in veterans. However, we also found that AA patients who appeared to be at low risk before CABG surgery had elevated mortality risk compared with low-risk Caucasian patients, consistent with the results of two previous studies conducted in non-VHA populations.

The finding of elevated mortality among AA patients who appeared to be at low risk before CABG surgery in both this study and prior studies indicates that current methods of preoperative risk assessment may be inadequate for AA patients. The greater prevalence of hypertension and higher baseline serum creatinine in AA patients suggests that we may underestimate the importance of factors such as left ventricular hypertrophy (LVH) and mild renal insufficiency as risk factors for adverse outcome. African American patients are more likely to have LVH than Caucasians, even with similar degrees of hypertension, and LVH has been associated with poor prognosis in other clinical settings (34,35). Mild renal insufficiency has been associated with adverse outcomes following CABG surgery (36).

To our knowledge, this is the first study to examine the impact of ethnicity on complications following CABG surgery. Overall, AA patients were 25% more likely than Caucasian patients to have complications following the operation in this study, and higher complication rates appeared to explain the elevated mortality seen in lower

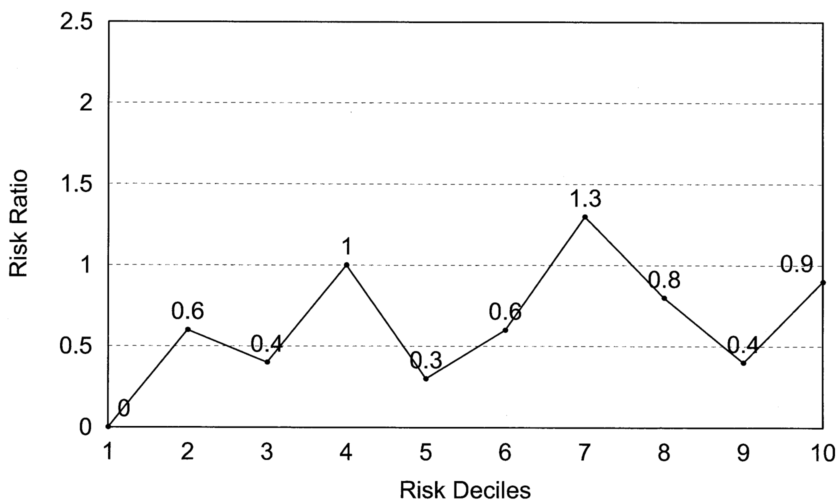

Figure 3. Risk ratios for 30-day mortality for Hispanic American versus Caucasian patients across deciles of preoperative risk.

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preoperative risk AA patients. In other words, many AA patients who appeared to be at low risk for mortality by traditional mortality risk factor assessment were actually at elevated risk for complications, which translated into their higher mortality risk. The higher risk for renal failure in AA patients following the operation was not surprising given the significantly higher baseline serum creatinine of this population, but the reasons for higher respiratory complications and re-operation for bleeding are unknown. Future studies are needed to elucidate the specific reasons for higher complication rates in AA patients and to devise strategies to reduce complications following the operation for these patients. In the interim, clinicians should be aware of the elevated risk of complications for AA patients, even among those who appear to be at low mortality risk before the operation.

The impact of HA ethnicity on outcomes following CABG surgery has not previously been evaluated. One previous study found similar 30-day and 1-year mortality rates between HA and Caucasian patients following myocardial infarction, and one study has reported similar risk-adjusted mortality following PCI for HA and Caucasian patients (37,38). Certainly, HA patients do not appear to be at increased risk for adverse outcomes following CABG surgery in the VHA. The reasons for lower mortality for HA patients found in this study are not readily apparent and warrant further evaluation. The overall risk profiles of the HA and Caucasian patients were similar, suggesting that the reason for lower mortality in HAs was not because lower risk patients were referred for the operation. Also, complication rates were similar between the two groups, suggesting that lower complication rate among HAs was not the reason for their lower mortality rates.

Strengths of this study include the use of an extensive, prospectively collected clinical dataset for risk adjustment. It has been shown that clinical data are more accurate than administrative data for evaluating risk-adjusted outcomes (39). Furthermore, we were able to evaluate the complete population of patients who underwent CABG in the VHA for the six-year period analyzed, thereby avoiding selection bias in the formation of the study population. We had complete follow-up data on all patients in the study, and were able to evaluate complications as well as short- and intermediate-term mortality. Finally, we had the ability to evaluate HA patients who have been poorly represented in published studies.

Potential limitations of this study should be addressed. First, the results may not be generalizable to non-VA populations. Second, data were derived retrospectively from an existing database not specifically designed to address the question of the impact of ethnicity on outcomes following CABG surgery, and ethnicity was missing in 4.3% of patients. However, we know of no a priori reason to expect that this small percentage of missing ethnicity data would bias our results. Third, there may be residual confounding in the relationship between ethnicity and the outcomes evaluated because of unmeasured variables, such as additional comorbidities, medications, and socioeconomic variables not captured in the VA cardiac surgery database. It should be noted that veterans are generally sicker and of lower socioeconomic status than non-VA populations (40). Also, there may be postsurgical variables that differ among ethnicities that could impact outcomes, but the focus of this study was to evaluate whether ethnicity is a risk factor for adverse outcomes from the perspective of preoperative risk assessment. Finally, this study did not evaluate for possible bias in referral for coronary angiography, but was instead focused on outcomes following CABG surgery.

Overall, this study is consistent with previous VHA studies that have found equal outcomes for minority patients for a variety of conditions (41–43). It has been suggested that this may be because the VHA operates a nationwide, government-funded health care system that has few financial barriers and, therefore, may promote equal quality of care for minority patients (42,43). In this case, it appears that ethnicity is not a strong risk factor for adverse outcomes following CABG surgery in the VHA. Even where the relative risks differed statistically (as between low-risk AA and Caucasian patients), the absolute risk differences were small, and the overall mortality rates for all the racial groups were low. Further investigation is needed to determine why AA patients have a higher risk of complications and whether this risk can be modified, but in the meantime ethnicity should not affect the decision to offer CABG surgery in the VHA.

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