Valvular Heart Disease

Treatment Variation in Older Black and White Patients Undergoing Aortic Valve Replacement

Erik B. Schelbert, MD; Gary E. Rosenthal, MD; Karl F. Welke, MD; Mary S. Vaughan-Sarrazin, PhD

Background—Most prior studies of racial differences in the delivery of cardiac care have focused on potential differences in treatment by individual physicians and hospitals. However, differential use of hospitals with variable practice patterns might also contribute to variations in care.

Methods and Results—We compared the use of bioprosthetic valves (BPVs) in 78,154 black and white Medicare beneficiaries ≥65 years of age undergoing aortic valve replacement in 904 US hospitals during 1999 through 2001. Generalized linear mixed models were used to account first for differences in patient characteristics and then for differences in hospitals used by black and white patients. BPV use was lower in black patients relative to white patients after adjustment for patient characteristics (relative risk, 0.93; 95% CI, 0.91 to 0.95; P<0.001). However, black patients were more likely to undergo surgery in hospitals in the lowest quintile of BPV use overall (29% versus 20% of white patients; P<0.001). After hospital-level variability in BPV use was accounted for, the use of BPVs was actually somewhat higher in black patients (relative risk, 1.06; 95% CI, 1.04 to 1.09; P<0.001). Model discrimination as measured by the c statistic was markedly higher after the addition of hospital effects (0.80 versus 0.59 for patient characteristics alone; P<0.001).

Conclusions—Accounting for differences in hospitals preferentially used by black and white patients had a major impact on estimating racial differences in the use of BPVs in patients undergoing aortic valve replacement. Hospital-level effects explained a larger proportion of the variation in BPV use than race and other patient characteristics alone.

(Circulation. 2005;112:2347-2353.)

Key Words: epidemiology ■ race ■ surgery ■ valves

Numerous studies have documented different patterns of cardiovascular care for black and white patients. Although most of these studies have controlled for differences in age, comorbidity, and other patient-level characteristics that influence treatment, fewer studies, particularly those in national populations, have accounted for differences in treatment patterns of hospitals that may be preferentially used by black and white patients. Failure to account for hospital differences may lead to incorrect inferences about the causes of racial variation and may lead to mistargeted efforts to eradicate disparities.

Prior research into sources of racial variation in cardiovascular care has focused largely on coronary revascularization. The generalizability of findings from this research to other cardiovascular conditions is unknown. Ideally, conditions chosen for studies of racial variation should have a well-defined evidence base with regard to best practices and guidelines that clearly indicate preferred treatments for particular types of patients. Aortic valve replacement (AVR) represents such a condition, given the wide dissemination of the American College of Cardiology/American Heart Association (ACA/AHA) guidelines. These guidelines recommend the use of bioprosthetic valves (BPVs) for AVR surgery for most patients ≥65 years of age because the risks of complications from anticoagulation required for mechanical valves generally exceed the risk of reoperation for failure of BPVs. This recommendation largely reflects the increased risk of anticoagulant-related hemorrhage and the increased lifespan of BPVs in older patients.

To examine sources of racial variation in valve type for patients undergoing AVR, we analyzed administrative data for Medicare beneficiaries undergoing aortic valve surgery during the 3-year period of 1999 through 2001 after publication of the ACA/AHA guidelines in 1998. Medicare data provide a unique opportunity to study this issue, given the recommendations in the guidelines for selecting BPVs in most patients ≥65 years of age undergoing AVR and the availability of Medicare data for patients undergoing AVR in nearly all nonfederal hospitals.
Methods

Patient Sample and Data Elements

The study used Medicare Provider and Analysis Review part A public-use data files, which were purchased from the Centers for Medicare and Medicaid Services. The part A files contain data available on the UB-92 hospital discharge abstract for a 100% sample of Medicare patients discharged from acute care hospitals and have been extensively used in health services research.8 Data elements included demographic information; patients’ zip code of residence; primary and secondary diagnoses and procedures as captured by International Classification of Diseases, 9th clinical modification (ICD-9-CM) codes; the diagnosis-related group; admission and discharge dates; disposition at the time of hospital discharge; and a 6-digit unique hospital identifier. In addition, zip code-level data on median household income and median home value were derived from the 2000 US Census data; patients were assigned values for these variables on the basis of the zip code of their residence.

Patients undergoing AVR in calendar years 1999 to 2001 who were ≥65 years of age were identified (n=87585) on the basis of specific ICD-9-CM procedure codes (35.21 and 35.22). Patients simultaneously receiving a prosthetic mitral (n=5735), tricuspid (n=126), or pulmonic (n=20) valve were excluded from this cohort. Patients undergoing AVR at facilities that did not perform AVR during the entire study period (n=1192) were also excluded, as were patients with obvious data coding errors (eg, date of discharge before the date of AVR) (n=42). Patients whose race was recorded as other than black or white were excluded (n=1956). These exclusions left a final study cohort of 78,514 patients, of whom 2753 (3.5%) were black. These patients received their care at 904 US hospitals. ICD-9-CM procedural codes were used to classify patients as undergoing either BPV AVR (35.21) or mechanical valve AVR (35.22).

Patient Variables Related to Valve Type

Patient characteristics for inclusion in the multivariable models were identified in 3 steps. First, bivariate associations between valve type and demographic variables and primary and secondary diagnosis and procedure codes that represented potential patient risk factors were determined with the Wilcoxon test or the \( \chi^2 \) statistic. Second, variables that were associated (\( P<0.05 \)) with the use of BPVs in bivariate analyses were entered into a stepwise logistic regression. Third, variables independently related to valve type (ie, bioprosthetic or mechanical) were identified in the logistic regression model using a statistical criterion of \( P<0.01 \). In all models, age was expressed as 5 indicator variables (70 to 74, 75 to 79, 80 to 84, 85 to 89, ≥90 years), with a referent category of 65 to 69 years. Year of AVR was expressed as either 2000 or 2001, with 1999 as the referent category. Surgical priority was expressed with 2 indicator variables for emergent and urgent admissions relative to elective admissions. Admission source was expressed as indicator variables for patients transferred to the hospital from another acute care facility and patients admitted through the emergency room, with a referent category that included primarily patients referred by a physician. Comorbid conditions were defined by ICD-9-CM codes with the criteria of Elixhauser et al.9 Variables significantly (\( P<0.05 \)) related to valve type selection in multivariable analysis were year of AVR surgery, age category, race, gender, angina, peripheral vascular disease, nonmetastatic cancer, coagulation disorder, peptic ulcer disease, and concurrent myocardial infarction. Other variables that were examined but were not related to valve type included diabetes, hypertension, endocarditis, prior coronary artery bypass surgery, arthritis, hypothyroidism, neurological disease, psychosis, chronic obstructive lung disease, and cerebrovascular disease.

Multilevel Modeling

Data analyses used generalized linear mixed models with a logit-link function to evaluate the relationship between race and the use of BPVs for valve replacement. The generalized linear mixed model is useful in situations in which data are clustered (ie, patients within hospitals) and allows one to decompose observed relationships between variables by cluster level. In this study, we decomposed the relationship between race and valve type into that which is explained by patient characteristics, the hospital where the patient was treated, and differential treatment of black and white patients across hospitals. Three separate models were developed to evaluate the contribution of these factors to valve type selection. Each model included a single overall coefficient for “black race” that was exponentiated to provide the odds of receiving a BPV for black patients relative to white patients. The 3 models incrementally included (1) fixed effects for patient demographic and clinical characteristics, (2) random intercepts for hospitals (ie, intercepts vary by hospital and reflect variation across hospitals in the overall use of BPVs), and (3) random coefficients for black race for each hospital (ie, coefficients for black race vary by hospital and reflect variability across hospitals in the use of BPVs in black patients relative to white patients).

All odds ratios associated with the model coefficients were converted to relative risk (RR) estimates to avoid inflation of likelihood because the outcome of interest (BPV use) was common (>10%).10 Model discrimination was determined using the \( c \) statistic.11 In addition, the strength of association between explanatory variables and the type of valve used was measured for each successive model by calculating the proportion of total squared deviations explained by each model12 (ie, a “pseudo-\( R^2 \)” based on squared error). First, the deviation for each patient was calculated as the difference between the observed use of BPV (measured with an indicator variable coded 1 for patients who received a BPV, 0 otherwise) and the overall sample probability of receiving a BPV. This measure was squared and summed over all patients to determine the total sum of squared deviations. Second, the deviation remaining after new variables were introduced in each successive model was calculated as the difference between the BPV indicator variable and the predicted probability of receiving a BPV, squared and summed over all patients. One minus the ratio of total remaining squared error to total squared variation provided a measure of the proportional reduction in error, analogous to \( R^2 \) in linear regression.12 This pseudo-\( R^2 \) and the \( c \) statistic were compared for each model.

To account for potential confounding of the relationship between race and valve type by socioeconomic status, we conducted additional analyses in which zip code-level socioeconomic markers (median household income and house value) were added to models, adjusting for patient-level risk factors and hospital-level variation.

Racial Patterns of Hospital Use and Rates of BPV Use

To investigate the extent to which black and white patients received care at hospitals with different valve selection patterns, risk-adjusted rates of BPV use were determined for each hospital using 3 steps. First, a generalized linear model was developed that used white patients only and patient-level covariates (except race). Second, the model based on white patients only was used to calculate the predicted probability of receiving a BPV (for white patients). Third, for each hospital, the observed rate of BPV use (for white patients) was divided by the predicted rate (ie, O:P ratio). This O:P ratio of BPV use reflects the relative use of tissue valves at a given hospital compared with the overall sample of hospitals. Calculation of O:P ratios included white patients only so that comparisons in the relative use of BPVs across hospitals are not confounded by the prevalence of minority patients at a given hospital.

Hospitals were then categorized into quintiles based on their O:P ratio, and the distribution of white patients and black patients across quintiles was examined. In addition, rates of BPV use for black and white patients were compared within quintiles.

Statistical analysis was performed with the SAS software system for Windows Version 8 (SAS Institute). Before the study was conducted, permission was granted from the University of Iowa Institutional Review Board.
Results of Multilevel Modeling

Ten risk factors met criteria for inclusion in the multivariable risk-adjustment model (Table 2): age (expressed as 5 indica-
tor variables); year of AVR surgery, female gender, angina pectoris, and several comorbid conditions (peripheral vascular disease, nonmetastatic cancer, coagulopathy, peptic ulcer disease, and primary diagnosis of acute myocardial infarction).

In the model that included patient characteristics only, black patients were less likely than white patients to receive BPVs (RR, 0.93; 95% CI, 0.91 to 0.95; P<0.001). This model had relatively poor discrimination, with a c statistic of 0.59 and proportional reduction in error of only 2% (Table 3). However, after hospital-level random effects were added (ie, accounting for hospital-level differences in BPV use), black patients were more likely to receive BPVs (RR, 1.06; 95% CI, 1.05 to 1.09). Although some of the RR ratios for other variables in the model had minor changes in magnitude, most differences were small, and none reversed direction. Incorporating hospital-level effects yielded markedly im-
proved discrimination compared with the model with patient characteristics only. The proportional reduction in error was 27%, and the c statistic was 0.80. In addition, the variance measure for hospital intercepts, which provides a measure of hospital-level variability in the use of BPVs, was statistically significant (1.63; P<0.001), indicating that BPV use varied significantly across hospitals, after controlling for patient characteristics.

Next, we incorporated random effects for the coefficient for black race to evaluate whether the relationship between race and valve type varied across hospitals. The variation in coefficients for black race was not significant (0.06; P=0.285), and addition of the random race coefficients did not improve model discrimination (c statistic, 0.80; pseudo-
\( R^2 \), 0.27). This suggests that, after controlling for the underlying practice patterns of hospitals, the relative difference in

---

**TABLE 1. Characteristics of Black and White Patients ≥65 Years of Age Undergoing AVR in US Hospitals During 1999 Through 2001**

<table>
<thead>
<tr>
<th>Variable</th>
<th>Black (n=2752)</th>
<th>White (n=75,762)</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Proportion, %</td>
<td>3.5</td>
<td>96.5</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Mean age, y</td>
<td>74.4</td>
<td>76.2</td>
<td></td>
</tr>
<tr>
<td>Age group distribution, %</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>65–69 y</td>
<td>26.1</td>
<td>15.6</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>70–74 y</td>
<td>25.7</td>
<td>24.7</td>
<td></td>
</tr>
<tr>
<td>75–79 y</td>
<td>27.3</td>
<td>29.3</td>
<td></td>
</tr>
<tr>
<td>80–84 y</td>
<td>14.9</td>
<td>21.2</td>
<td></td>
</tr>
<tr>
<td>≥90</td>
<td>5.2</td>
<td>7.9</td>
<td></td>
</tr>
<tr>
<td>Gender, %</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>51.6</td>
<td>42.1</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Male</td>
<td>48.4</td>
<td>57.9</td>
<td></td>
</tr>
<tr>
<td>BPV use, %</td>
<td>43.0</td>
<td>48.6</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Prior MI, %</td>
<td>7.7</td>
<td>6.5</td>
<td>0.009</td>
</tr>
<tr>
<td>Prior CABG, %</td>
<td>2.1</td>
<td>4.4</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Concurrent CABG, %</td>
<td>44.4</td>
<td>56.4</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Prior PCI, %</td>
<td>2.0</td>
<td>3.0</td>
<td>0.002</td>
</tr>
<tr>
<td>Angina, %</td>
<td>8.7</td>
<td>10.0</td>
<td>0.021</td>
</tr>
<tr>
<td>Heart failure, %</td>
<td>44.6</td>
<td>33.8</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Peripheral vascular disease, %</td>
<td>11.4</td>
<td>9.4</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Diabetes, %</td>
<td>25.4</td>
<td>17.3</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Hypertension, %</td>
<td>48.3</td>
<td>43.2</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Chronic renal insufficiency, %</td>
<td>9.5</td>
<td>3.3</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Coagulopathy, %</td>
<td>11.1</td>
<td>9.8</td>
<td>0.021</td>
</tr>
<tr>
<td>Iron-deficiency anemia, %</td>
<td>9.5</td>
<td>7.1</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Nonmetastatic cancer, %</td>
<td>5.9</td>
<td>7.5</td>
<td>0.002</td>
</tr>
<tr>
<td>Emergent AVR, %</td>
<td>26.1</td>
<td>16.2</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Hypothyroidism, %</td>
<td>3.2</td>
<td>6.7</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Endocarditis, %</td>
<td>0.3</td>
<td>0.1</td>
<td>0.047</td>
</tr>
</tbody>
</table>

MI indicates myocardial infarction; PCI, percutaneous coronary intervention.

**TABLE 2. Patient-Level Factors Independently (P<0.01) Related to the Use of BPVs in a Generalized Linear Model With Fixed Effects**

<table>
<thead>
<tr>
<th>Variable</th>
<th>RR</th>
<th>95% CI</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>AVR in 2000*</td>
<td>1.09</td>
<td>1.08–1.10</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>AVR in 2001*</td>
<td>1.16</td>
<td>1.15–1.17</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Age, y</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>70–74†</td>
<td>1.28</td>
<td>1.27–1.30</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>75–79†</td>
<td>1.41</td>
<td>1.39–1.43</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>80–84†</td>
<td>1.52</td>
<td>1.51–1.54</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>≥90†</td>
<td>1.58</td>
<td>1.56–1.60</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Female gender</td>
<td>0.96</td>
<td>0.96–0.97</td>
<td>0.001</td>
</tr>
<tr>
<td>Angina</td>
<td>1.08</td>
<td>1.06–1.09</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Peripheral vascular disease</td>
<td>0.93</td>
<td>0.92–0.94</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Nonmetastatic cancer</td>
<td>1.07</td>
<td>1.05–1.08</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Coagulation disorder</td>
<td>1.06</td>
<td>1.05–1.07</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Peptic ulcer disease</td>
<td>1.10</td>
<td>1.06–1.13</td>
<td>0.004</td>
</tr>
<tr>
<td>Black race</td>
<td>0.93</td>
<td>0.91–0.95</td>
<td>0.015</td>
</tr>
<tr>
<td>Concurrent myocardial infarction</td>
<td>1.06</td>
<td>1.04–1.08</td>
<td>0.003</td>
</tr>
</tbody>
</table>

*Referent category is AVR during 1999.
†Referent category is age 65 to 69 years.
the treatment of black and white patients is generally constant and does not vary substantially across hospitals.

Lastly, we incorporated zip code–level measures of median and household income and median house value status to identify potential confounding by socioeconomic status. In these analyses, neither of the 2 measures was associated (P/H11022<0.10) with valve type. Moreover, the odds ratio associated with black race was essentially unchanged (1.07; 95% CI, 1.05 to 1.10 with the addition of median household income; 1.07; 95% CI, 1.05 to 1.10 with the addition of median house value).

Racial Patterns of Hospital Use and Hospital Rates of BPV Use

The racial composition of patients across quintiles of median rates of BPV use for black and white patients was similar within categories of hospitals defined by the O:P ratio, as shown in Figure 2. Among hospitals that are least likely to use BPVs (ie, lower quintile defined by O:P), black patients had slightly higher rates of BPV use compared with white patients (17% versus 13%; P=0.001), and among hospitals that are most likely to use BPVs (ie, highest quintile defined by O:P), black patients had slightly lower rates of BPV use (79% versus 83%; P=0.044). Among hospitals in the other quintiles, the use of BPVs for black and white patients was similar.

Discussion

The present study represents one of the first large-scale national analyses of racial variation in valve type among hospitals defined by the expected use of BPV valves (ie, O:P ratio) varied significantly (Mantel-Haenszel \( \chi^2 = 183; P<0.0001 \)). Black patients were most likely to receive AVR at hospitals where the rates of BPV use were lowest and least likely to receive AVR where rates of BPV use were higher (Figure 1). There were nearly twice as many black patients receiving AVR at hospitals in the lowest O:P quintile than in the highest O:P quintile. Specifically, 28% (n=783) of the sample of black patients received care at hospitals with the lowest rates of BPV use (O:P quintile 1), 20% (n=560) of the sample of black patients received care at hospitals with the second-lowest rates of BPV use (O:P quintile 2), and 20% (n=550) of the sample of black patients received care at hospitals with intermediate rates of BPV use (O:P quintile 3). A significantly smaller proportion of black patients received AVR at hospitals with high rates of BPV use (15% [n=419] at O:P quintile 4; 16% [n=440] at O:P quintile 5).

In general, rates of BPV use for black and white patients were similar within categories of hospitals defined by the O:P ratio, as shown in Figure 2. Among hospitals that are least likely to use BPVs (ie, lower quintile defined by O:P), black patients had slightly higher rates of BPV use compared with white patients (17% versus 13%; P=0.001), and among hospitals that are most likely to use BPVs (ie, highest quintile defined by O:P), black patients had slightly lower rates of BPV use (79% versus 83%; P=0.044). Among hospitals in the other quintiles, the use of BPVs for black and white patients was similar.

Discussion

The present study represents one of the first large-scale national analyses of racial variation in valve type among hospitals defined by the expected use of BPV valves (ie, O:P ratio).
patients undergoing AVR. Analyzing older Medicare patients undergoing AVR over a 3-year period after the publication of national guidelines for the selection of valve type, the study found that hospital-level differences explained a much larger proportion of the overall variation in valve selection than patient-level characteristics. The study also found that accounting for hospital-level differences reversed the direction of the differences in valve type in black and white patients. Although analyses adjusting only for patient characteristics found that black patients were less likely to receive BPVs, analyses that further accounted for hospital-level differences found that black patients were somewhat more likely to receive BPVs. Additional analyses detected little variability in the differential treatment of black and white patients across hospitals; the tendency toward greater use of BPV for black patients was generally consistent across hospitals.

Taken together, these striking findings highlight the importance of accounting for differential use of providers with different practice patterns in analyses of racial variation. With risk-adjusted BPV use (ie, O:P ratio) as a proxy for guideline adherence, hospitals with higher risk-adjusted rates of BPV use were considered more guideline adherent. Indeed, the findings suggest that, in the case of AVR, racial variation in care may be less a reflection of differences in treatment patterns by individual providers and more a reflection of differential access to providers more likely to provide guideline concordant care. Thus, the present study may serve as a useful paradigm for evaluating racial differences in healthcare delivery.

Although the magnitude of the differences in valve type between black and white patients is modest, the findings indicate, somewhat unexpectedly, that black patients were more likely than white patients to receive guideline-concordant treatment, after accounting for hospital-level variation. The reasons for this treatment pattern are unclear and may reflect unmeasured variation in patient characteristics or in clinical indications for a specific valve type. The observed differences may also reflect differences in patient or physician preferences. For example, black patients may be less willing to accept the risks of long-term anticoagulation that is required for mechanical valves.

Alternatively, black patients may have received a BPV in accordance with guidelines for more spurious reasons. Physician expectations about patient preferences and behavior may drive the recommended valve type, whether these expectations are based on prior experience with the patient or a preconceived bias. For example, a physician may anticipate that the patient would prefer to avoid long-term anticoagulation therapy or that the patient is unlikely to comply with the mandatory anticoagulation required by mechanical valves and thus recommend a BPV. Furthermore, prior studies indicate that black patients are less likely to have established primary care relationships. The lack of an identifiable primary care provider might make physicians reluctant to recommend a treatment, like mechanical valves, that requires close long-term monitoring to avoid potentially catastrophic complications.

Our study is consistent with recent literature documenting differential access to quality providers across racial and ethnic groups. A recent examination of time to reperfusion for patients with acute myocardial infarction identified differential access to hospitals with varying practice patterns as an important contributor to racial differences in care. Other research has documented that minority patients in primary care settings may receive treatment from lesser trained physicians who have less access to important resources. In support of differential access to specialized care, black patients appear underrepresented in our sample (3.5%), given that black persons constitute >9% of the population of black and white Medicare enrollees >65 years of age, according to recent data. It is not surprising then to find similar patterns when minority patients ultimately require treatment at tertiary care facilities for complex procedures such as valve replacement surgery.

Racial inequity in cardiac care might arise fundamentally from a shortage of high-quality care that disproportionately affects black patients. The overall low rates of BPV use in this cohort have been discussed elsewhere. As noted by the Institute of Medicine, current dissemination practices may fail to reach many clinicians and patients, and there are insufficient tools and incentives to promote rapid adoption of best practices. Thus, a 2-pronged approach that targets both low-quality care and barriers to access might be most effective in eliminating racial inequity. This notion is in contrast to other investigations that have focused on various aspects of the patient-physician relationship. Until recently, properties of the healthcare system that implicitly deal with issues of access have received less attention.

Our study has several limitations. First, to the best of our knowledge, no prior studies have examined the reliability of the coding for bioprosthetic and mechanical valves in administrative data. Our findings, however, agree with prior reports that cite predominant use of mechanical valves in older patients. Moreover, if misclassification of valve type does occur, the pattern would likely be random, would minimize the magnitude of our findings, and would unlikely differ systematically in black and white patients in individual hospitals. Nonetheless, these findings should be replicated in clinical databases that are assembled under stricter data collection protocols.

Second, the administrative data used for this study did not allow us to account for relevant comorbidities (eg, systolic function, risk factors for thromboembolism) that may affect valve choice or the severity of the comorbidities that were assessed. Specifically, we were unable to identify patients with preoperative atrial fibrillation in whom receipt of a mechanical valve would be more likely because their need for some type of anticoagulation might persist regardless of valve type. However, the reported rate of preoperative atrial fibrillation for AVR in older patients of only 16% probably does not account for the high rates of mechanical valve implantation observed in our analysis. Furthermore, some patients who have indications for anticoagulation but also questionable tolerance of anticoagulation might still receive a BPV. Other patients may already have mechanical valves in other positions and are already committed to anticoagulation, but this situation is relatively uncommon and would be unlikely to explain our findings. Thus, on average, the unexplained
variation in the use of BPV across hospitals is likely due to differences in hospital practices rather than differences in patient characteristics. Moreover, our previous study found a strong relationship between hospital AVR volume and the use of BPVs in older patients undergoing AVR. Given the extensive prior research linking surgical volumes to mortality for cardiac surgery, we believe that the risk-adjusted measure of BPV use is a reasonable marker for hospital quality.

Third, the designation of race is based on information recorded in the discharge abstract and might not match patients’ self-described race. Fourth, the database did not include unique physician identifiers. Thus, we were unable to account for differences in practice of individual physicians. Finally, this study has not considered other clinically relevant outcomes such as postoperative complications or survival. Although at least 1 recent article revealed no racial differences in operative mortality for AVR, the significance of these findings must nevertheless be considered in the context of other clinically relevant outcomes.

In conclusion, our study demonstrates that black patients were more likely to undergo AVR in hospitals that are less likely to deliver guideline-concordant care. However, within individual hospitals, black patients were actually more likely to receive guideline-concordant BPVs. Although the factors underlying the higher use of BPVs in black patients are unclear, these findings are nonetheless reassuring from the standpoint of prior studies that have suggested racial disparities in treatment arising from individual providers. Thus, improving access to higher-quality providers through dissemination of reports cards or other mechanisms may represent a promising vehicle for eradicating racial disparities in health care.

Finally, the findings highlight the importance of explicit accounting for differences in sites of care in studies of racial variation. Failure to do so may lead to incorrect inferences about the underlying reasons for differences in care for particular conditions.

Acknowledgments

For data acquisition, management, and analysis, this research was supported in part by an award (HFP 04-149) from the Health Services Research and Development Service, Veterans Health Administration, Department of Veterans Affairs. Dr Rosenthal is a Senior Quality Scholar, Office of Academic Affiliation, Veterans Health Administration. Dr Schelbert was supported by a Cardiovascular Interdisciplinary Fellowship (HL 07121) from the University of Iowa Division of Cardiovascular Diseases and the Cardiovascular Research Center, where he was an Iowa Scholar in Clinical Investigation Program K30 trainee (K30HL04117-01A1).

Disclosure

Dr Schelbert had full access to all of the data in the study and takes responsibility for the integrity of the data and the accuracy of the data analysis. The views expressed in this article are those of the authors and do not necessarily represent the views of the Department of Veterans Affairs.

References


Treatment Variation in Older Black and White Patients Undergoing Aortic Valve Replacement
Erik B. Schelbert, Gary E. Rosenthal, Karl F. Welke and Mary S. Vaughan-Sarrazin

Circulation. 2005;112:2347-2353; originally published online October 3, 2005;
doi: 10.1161/CIRCULATIONAHA.104.530550
Circulation is published by the American Heart Association, 7272 Greenville Avenue, Dallas, TX 75231
Copyright © 2005 American Heart Association, Inc. All rights reserved.
Print ISSN: 0009-7322. Online ISSN: 1524-4539

The online version of this article, along with updated information and services, is located on the World Wide Web at:
http://circ.ahajournals.org/content/112/15/2347

Permissions: Requests for permissions to reproduce figures, tables, or portions of articles originally published in Circulation can be obtained via RightsLink, a service of the Copyright Clearance Center, not the Editorial Office. Once the online version of the published article for which permission is being requested is located, click Request Permissions in the middle column of the Web page under Services. Further information about this process is available in the Permissions and Rights Question and Answer document.

Reprints: Information about reprints can be found online at:
http://www.lww.com/reprints

Subscriptions: Information about subscribing to Circulation is online at:
http://circ.ahajournals.org//subscriptions/