Understanding the Racial Disparity in the Receipt of Endovascular Abdominal Aortic Aneurysm Repair

Nicholas H. Osborne, MD, MS; Amit K. Mathur, MD, MS; Gilbert R. Upchurch Jr, MD; Justin B. Dimick, MD, MPH

Hypothesis: Racial disparity exists in the management of abdominal aortic aneurysms (AAAs) using new health care technology.

Design: Retrospective cross-sectional study.

Setting: Medicare database (January 1, 2001, to December 31, 2006).

Patients: All patients who underwent open or endovascular AAA repair were identified (N=160,785).

Main Outcomes Measures: The relationship between race and the type of AAA repair (open vs endovascular), controlling for differences in patient factors and adjusting for the hospitals where patients received care.

Results: Accounting for differences in patient comorbidities and neighborhood socioeconomic status, black patients were 33% less likely than nonblack patients to undergo endovascular AAA repair (odds ratio, 0.67; 95% confidence interval, 0.63-0.71). Black patients treated in hospitals with the highest proportions of black patients having AAA repair underwent endovascular AAA repair less often than black patients treated in hospitals with the lowest proportions of black patients having AAA repair (31.0% vs 39.6%, P<.05). Accounting for differences in the hospitals where they received care, black patients continued to have a significantly lower rate of endovascular AAA repair (odds ratio, 0.73; 95% confidence interval, 0.67-0.78).

Conclusions: Despite controlling for differences in patient characteristics and the hospitals where they received care, black patients were still less likely to undergo endovascular AAA repair. Efforts aimed at improving this disparity will need to explore the causes of these treatment differences.

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We compared characteristics between black and nonblack patients using χ² analysis for categorical variables and t test or analysis of variance for continuous variables. Unadjusted and adjusted rates of endovascular AAA repair were compared using multivariate logistic regression. Risk-adjusted rates controlled for acuity of admission, patient comorbidities (using methods described by Elixhauser et al⁴), year of admission and neighborhood socioeconomic status (as previously described by Birkmeyer et al⁴), and patient-level differences in age, sex, race, and their interactions. The index by Elixhauser et al⁴ is a method of adjusting for patient comorbidities that has been validated in investigations of medical and surgical admissions. To adjust for differences in neighborhood socioeconomic status, we used a composite measure based on the 2000 US Census.⁵ This includes multiple measures of neighborhood socioeconomic status across the following 3 domains: (1) wealth and income (defined using median household income, median value of housing units, and proportion of households with interest, dividend, or rental income), (2) education (defined using proportion of adult residents completing high school and proportion of adult residents completing college), and (3) employment (proportion of employed residents with management, professional, and related occupations).⁵

Next, to determine the effect of black patients’ receiving care in hospitals different from those where nonblack patients receive care (ie, segregation), we used 2 independent methods—stratification and fixed-effects modeling—which were previously described in an analysis of racial disparities in mortality associated with AAA repair.⁶ Initially, we grouped hospitals into 5 equal-sized groups (quintiles) based on the proportions of black patients undergoing AAA repair. Because the first quintile contained no black patients, it was omitted from the stratified analysis. Subsequently, we compared the risk-adjusted rates of endovascular AAA repair among black and nonblack patients using multivariate logistic regression within the remaining 4 strata.

Independent of the stratified analysis, we also determined the effect of individual hospitals where patients received care using fixed-effects regression models. Fixed-effects modeling is a statistical technique that allows adjustment for all hospital-level factors that affect the type of AAA repair that patients undergo, regardless of race, isolating differences in the use of endovascular AAA repair within each hospital.⁷ Using this approach, we can assume that differences in the rates of endovascular therapy are owing to variations in where patients received treatment if the differences are no longer significant in the fixed-effects model (compared with nonblack patients, black patients receive care in hospitals that are less likely to perform endovascular AAA repair).

We performed all statistical analyses using commercially available software. The program used was STATA 10 (StatCorp LP, College Station, Texas).

Black patients comprised 4.4% (n=6988) of all patients undergoing AAA repair (N=160 785). Forty-three percent (n=68 494) of all patients underwent endovascular AAA repair. Twenty-four percent of black patients underwent endovascular AAA repair compared with 43.0% of nonblack patients (P < .001). Black patients were younger and (except for chronic obstructive pulmonary disease) had more comorbidities compared with nonblack patients (Table). Similarly, black patients were more likely to undergo an emergency or urgent repair than nonblack patients (30.0% vs 18.1%, P <.001).

Black patients were 36.0% less likely to undergo endovascular AAA repair of a nonruptured AAA (odds ratio [OR], 0.64; 95% confidence interval [CI], 0.61-0.67). After controlling for patient comorbidities, black patients continued to be 33.0% less likely to undergo endovascular AAA repair (OR, 0.67; 95% CI, 0.63-0.71). Controlling for neighborhood socioeconomic status had no effect; black patients still had a 33.0% lower likelihood of undergoing endovascular AAA repair (OR, 0.67; 95% CI, 0.63-0.71). We estimate that about 8.0% of the disparity in the use of endovascular AAA repair can be explained by patient demographics and comorbidities.

Stratifying hospitals by the proportions of black patients who underwent AAA repair, there was significant segregation of black patients. The proportions of black patients treated for AAA repair in hospitals ranged from 0% in the lowest quintile to 63.6% in the highest quintile (Figure 1). Figure 2 shows the rates of endovascular AAA repair for black and nonblack patients in hospitals stratified by the proportions of black patients who underwent AAA repair. Among all hospitals, nonblack

### Methods

#### DATA SOURCE AND POPULATION

Using the Medicare Provider Analysis and Review claims data file, we identified all nonruptured AAA repairs performed among Medicare beneficiaries 65 years and older between January 1, 2001, and December 31, 2006. To identify the study population, we used the International Classification of Diseases, 9th Edition, Clinical Modification (ICD-9-CM) diagnostic code for AAA and the ICD-9-CM procedure code for open or endovascular AAA repair, excluding patients with a diagnosis code for ruptured aneurysm. The acuity of procedure was classified as elective vs emergency or urgent using the admission status variable. Race was dichotomized as black or nonblack. Zip code–level census data from 2006 were linked to the data set using the zip code of residence. Our primary outcome measure was receipt of endovascular AAA repair.

#### DATA ANALYSIS

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### Table. Patient Characteristics and Comorbidities by Race (Medicare Provider Analysis and Review Claims Data File, 2001-2006)

<table>
<thead>
<tr>
<th>Variable</th>
<th>Black Patients</th>
<th>Nonblack Patients</th>
<th>P Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male sex, %</td>
<td>57.3</td>
<td>74.8</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Age, mean, y</td>
<td>74.3</td>
<td>75.4</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Emergency or urgent surgery, %</td>
<td>30.0</td>
<td>18.1</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Comorbidity, %</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>≥2</td>
<td>74.2</td>
<td>64.3</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Congestive heart failure</td>
<td>0.8</td>
<td>0.6</td>
<td>&lt;.01</td>
</tr>
<tr>
<td>Chronic obstructive pulmonary disease</td>
<td>28.3</td>
<td>36.0</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Peripheral vascular disease</td>
<td>40.7</td>
<td>34.7</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Diabetes</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Uncomplicated</td>
<td>16.5</td>
<td>11.9</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Complicated</td>
<td>2.4</td>
<td>0.9</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Chronic renal failure</td>
<td>10.3</td>
<td>5.2</td>
<td>&lt;.001</td>
</tr>
</tbody>
</table>
patients had similar rates of endovascular AAA repair (range, 42.9%-46.5%). In contrast, black patients treated in hospitals with the highest proportions of black patients having AAA repair underwent endovascular AAA repair less often than black patients treated in hospitals with the lowest proportions of black patients having AAA repair (31.0% vs 39.6%, P < .05). In hospitals treating the highest proportions of black patients having AAA repair, black patients were 32.0% less likely than nonblack patients to undergo endovascular AAA repair (OR, 0.68; 95% CI, 0.63-0.76).

After adjusting for differences in the treating hospitals, black patients continued to have a significantly lower rate of endovascular AAA repair than nonblack patients (OR, 0.73; 95% CI, 0.67-0.78). We estimate that about 17.0% of the observed disparity in the receipt of endovascular AAA repair is because of black patients’ receiving care in hospitals different from those where nonblack patients receive care. Eight percent of the disparity can be explained by accounting for differences in patient factors. The remaining unexplained 75.0% of the disparity is caused by unmeasured differences in the treatment of patients within the same hospitals.

**COMMENT**

Compared with nonblack patients, black patients experience a significantly lower rate of endovascular AAA repair. This disparity in the treatment of AAAs could not be explained by variations in patient factors, including demographics, neighborhood socioeconomic status, and comorbidities, accounting for only about 8% of the disparity. Seventeen percent of the disparity in treatment could be explained by differences in the hospitals where black and nonblack patients received vascular care. Most important, about 75% of the disparity in endovascular treatment could not be explained by differences in patient characteristics or by the hospital where black and nonblack patients received care. Differences in the treatment of AAAs may be caused by unmeasured patient factors (eg, severity of disease, aneurysm size, and anatomical variation) or because of variations in the health care that black and nonblack patients receive (eg, patient preferences or physician bias).

Previous studies of racial disparities in the treatment of AAAs had mixed findings. Using Medicare claims data, Dimick and Upchurch also demonstrated that black patients had a lower rate of endovascular AAA repair. Using the New Jersey State Inpatient Database, Vogel et al found no difference in the receipt of endovascular AAA repair between black and nonblack patients. The present study demonstrates a significant racial difference in the receipt of endovascular AAA repair among Medicare beneficiaries. In addition, our study explores the potential mechanisms of these disparities in the use of endovascular AAA repair, demonstrating that most variation is unexplained by observable patient factors or by differences in the hospitals where patients received care.

Several mechanisms may be responsible for racial disparities in the treatment of AAAs within hospitals. Black patients may be treated differently because of unmeasured patient factors, including severity of disease, aneurysm size, anatomical variation, and alterations in presentation. However, no previous studies to date have reported anatomical differences in AAAs between racial groups. A single study documents vascular anatomical variation in black vs nonblack patients when evaluated for peripheral vascular disease. Sidawy et al published a case series demonstrating more severe lesions and higher rates of infragenicular peripheral vascular disease in black patients. Although no data exist to our knowledge, it is plausible that black patients may be predisposed to AAAs that are unsuitable for endovascular AAA repair and that this may explain some of the disparity in treatment. However, it is unlikely that all the discrepancy can be explained by anatomical differences alone. Similarly, black patients may be initially seen at later stages of disease, as suggested by higher rates of emergency and ruptured AAA repairs. These larger and more complex aneurysms may be less amenable to endovascular AAA repair. A more clinically rich understanding of the factors involved in the decision to perform open vs endovascu-
lar repair of an AAA will be necessary to further understand these disparities in the treatment of aneurysms within hospitals.

In addition to unmeasured anatomical and disease factors, treatment differences could also be owing to variations in primary care physician bias or inpatient preference. Green et al.11 showed that unconscious (implicit) racial bias among primary care physicians may contribute to disparities in the use of medical procedures, including thrombolysis for myocardial infarction. In contrast, disparities in the receipt of endovascular therapy may arise because of patient mistrust. Previous studies12-15 have noted that disparate beliefs and attitudes are important factors in explaining differences in treatment between black and nonblack patients. Mistrust of the medical system, particularly of newer treatments, coupled with fears of experimentation may contribute to relative underuse of endovascular technology.

This study has several important limitations. The limitations of Medicare data are well known. Although the use of Medicare data provides the necessary sample size to examine the relationships between race, hospital, and receipt of endovascular AAA repair, it limits our analysis to patients 65 years and older. However, this age group represents most patients with AAs, accounting for 70% of all AAA repairs performed in the United States.16 A further limitation is that the Medicare database provides limited clinical details from ICD-9-CM coding for risk adjustment. Although more clinical information (especially patient factors influencing the type of repair) is important, no large population-level databases exist with this level of information. Using the existing data, we controlled for age, sex, race, patient comorbidities, and acuity of admission. In the future, richer clinical detail would improve our ability to adequately account for differences in case mix.

Results of our analyses indicate that racially inequitable care among patients with vascular disease is real and remains largely unexplained. New research using qualitative research methods, including surveys, focus groups, and patient–primary care physician interviews, will be necessary to understand why significant differences in treatment exist within the same hospitals. These further studies will be instrumental in clarifying whether patient preference or primary care physician bias is contributing to the treatment disparities. Further equity needs to be established among hospitals to achieve less disparate outcomes for the populations served. Investment in a quality improvement infrastructure for all patients in resource-poor hospitals will likely improve outcomes for the most disadvantaged patients. Improving access to vascular care for black patients and for patients with low neighborhood socioeconomic status could lead to decreased rates of ruptured aneurysms and to fewer large aneurysms that are unsuitable for endovascular AAA repair. These research and policy interventions will not only inform and improve our understanding of racial/ethnic disparities in vascular disease but also will lead to more effective interventions in health care at large.

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REFERENCES