Explaining Racial Variation in Lower Extremity Amputation

A 5-Year Retrospective Claims Data and Medical Record Review at an Urban Teaching Hospital

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Hypothesis: Population-based hospital data indicate that African American patients undergo major lower extremity (LE) amputation 2 to 3 times more frequently than white patients. Some have attributed this to a lack of access to LE revascularization procedures by African American patients. To determine the likelihood that racial disparities in amputation rates are related to treatment choice, this study examines rates of primary amputation (major amputation without any previous attempt at revascularization) and repeat amputation.

Design and Setting: Two-step case-control study, reviewing experience at a large midwestern teaching hospital. First, administrative discharge data for all 1127 patients undergoing LE arterial bypass graft, angioplasty, or major amputation from January 1, 1995, to February 1, 2000, were used to analyze racial differences in the risk of admission for major amputation vs revascularization. Medical records were then reviewed for an approximate full sample of 60 African American major amputees and a random sample of 60 (two thirds of the total) white major amputees. Racial disparities in frequency of primary and repeat amputation were analyzed, controlling for age, sex, and diabetes mellitus status.

Outcome Measures: Among all patients admitted for LE ischemia, outcome measures were the odds of amputation vs revascularization, and among a sample of African American and white amputees, the odds of primary vs repeat major amputation.

Results: Among all patients hospitalized for LE ischemia, African American patients were younger (P<.05), more often female (P<.01), and more likely to undergo major amputation (odds ratio, 1.68; P=.005). However, after adjusting for age, sex, and diabetes mellitus prevalence, the analysis revealed an equal likelihood of primary amputation among African Americans and whites. Repeat amputees were 2.5 times more likely to be African American than white (P=.04).

Conclusion: The racial disparity at the study institution was primarily due to African American patients undergoing repeat major amputation at a significantly higher rate than whites.

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secondary amputation, for patients with failed prior LE revascularization procedures, and (2) the proportion of amputees of each race undergoing a repeat major amputation after prior above-knee, below-knee, or through-foot amputation.

The study hospital has a well-equipped vascular surgery service with an aggressive policy of limb salvage. Therefore, if indications for major amputation vs revascularization at the study hospital do not differ by race, it would imply that well-documented regional disparities may largely be a function of racial differences in admission to less well-equipped hospitals, where lower-income, inner-city residents may be denied limb salvage treatment options. Conversely, if disparities in amputation rates exist at the study hospital, which has an extensive vascular surgery service, it is of interest whether these differences are related to indications for primary or repeat amputation. A finding of a disparity in the primary or repeat amputation rates has important implications for future approaches to treatment and prevention.

**METHODS**

**ANALYSIS OF RACIAL DIFFERENCES IN PROCEDURE RATES**

Institutional review board approval was obtained from Northwestern University. Administrative claims from the study hospital’s database from January 1, 1995, to February 1, 2000, were selected for all patients discharged with International Classification of Diseases, Ninth Revision (ICD-9) procedure codes for LE bypass, angioplasty, or major amputation (codes 39.25, 39.29, 39.50, 84.15, or 84.17). The chronologically first (index) admission was then used for patient-level racial comparisons (African American, white, or other race) by procedure type. Admissions of patients younger than 35 years and admissions related to trauma were excluded. Multiple logistic regression was used to test the significance of race in predicting major amputation vs revascularization, controlling for age, sex, and diabetes mellitus status as indicated by ICD-9 coding.

**MEDICAL RECORD REVIEW OF AMPUTATION ADMISSIONS**

In the next stage of the study, a sample of medical records was reviewed for 60 African American amputees (approximately 95% of all African Americans who underwent amputation during the study) and a randomly selected sample of 60 white amputees. Patient records for Hispanics (primarily Mexican American and Puerto Rican) and Asians were not reviewed because of a lack of sufficient statistical power for inferences about study hypotheses. Because differences in mean demographic and clinical characteristics (eg, age, sex, and diabetes mellitus status) were of primary interest, differences in means and proportions were examined, rather than matching patients individually. The 60-subject sample size provided 80% power to detect a difference between a 33% vs a 60% primary or repeat amputation rate in a 2-tailed χ² test of proportions at P = .05. Demographics and functional status were abstracted from admission notes. Diabetes mellitus and diabetic sequelae (peripheral neuropathy, retinopathy, renal insufficiency, end-stage renal disease, or dialysis) were determined from medical record documentation or medication use. (The hemoglobin A₁c measure was not routinely available in this population.) The presence of hypertension was documented by the use of antihypertensive medications. Tobacco use was defined as any tobacco use in the last year. The use of antiplatelet agents, including aspirin, ticlopidine hydrochloride, dipyridamole, and heparin sodium, was recorded. A history of angioplasty or bypass surgery was abstracted from the medical history to determine whether the patient was a primary or secondary amputee. The presence or absence of presenting foot and leg disease manifestations (gangrene, infection, ulceration, abscess, fasciitis, cellulitis, or osteomyelitis) was ascertained from surgical and medical documentation. Infection status was based on documentation of the use of antibiotics before or on admission. Angiogram results were recorded when documented. Transatlantic Intersociety Consensus on the Management of PAD criteria for amputation (unreconstructable disease, limited life expectancy, or advanced necrosis), preadmission functional status, and American Society of Anesthesiologists class were collected when documented.

Five physician medical record reviewers, trained and supervised by us, ascertained study eligibility with regard to race and verification of a vascular- or diabetes mellitus–related major amputation. Patients undergoing prior amputations at any level, with or without prior diagnostic angiography but without any subsequent revascularization procedures, were classified as primary amputees. Presenting foot and leg symptoms were graded on the basis of the presence of infection, gangrene, or osteomyelitis and the extent of ulceration at the toe, heel, foot, or above-ankle levels.

**COMORBIDITY measurement**

The severity of comorbid illness was measured by chronic disease risk factors derived from the Department of Veterans Affairs National VA Surgical Quality Improvement Program. This instrument, used for the last 9 years in the Department of Veterans Affairs, has been widely tested as a severity risk adjustment for perioperative mortality for noncardiac surgery in general and for vascular procedures in particular. Approximately 40 National VA Surgical Quality Improvement Program preoperative medical history items were reviewed (excluding laboratory findings). These included American Society of Anesthesiologists class, functional status, behavioral health, and a survey of possible disorders across 8 organ systems. Based on these findings, each patient was then assigned a cumulative chronic disease severity score based on an amputation level–specific index. The index reflects the survival probabilities from a published hazards model of late survival after major amputation, based on more than 4000 Department of Veterans Affairs patients undergoing above- and below-knee amputation in the mid 1990s.

**STATISTICAL ANALYSIS**

χ² Tests were used to compare categorical differences between groups; t tests were used to compare differences between continuous variables. Multiple logistic regression was used to test the hypothesis that African American amputees, compared with white amputees, had significantly different log odds of primary or repeat amputation, adjusting for age, sex, and diabetes mellitus prevalence.

**RESULTS**

**ADMISSIONS FOR AMPUTATION VS REvascularization**

Table 1 presents data on the index admissions of all 1127 patients who underwent LE bypass, angioplasty, or amputation between 1995 and 2000. Compared with white patients, African Americans were on average 2 years younger.
(P < .05), were more often female (53% vs 36%, P < .01), and had a greater likelihood of having diabetes mellitus (45% vs 37%, P = .07). Table 2 presents multiple logistic regression results, controlling for age, sex, and diabetes mellitus prevalence, for the likelihood of major amputation vs revascularization. Mirroring regional findings,6 African Americans were 1.7 times more likely than other patients to be admitted for a major amputation rather than a revascularization procedure (P = .005). Diabetes mellitus prevalence (odds ratio, 1.58; P = .006), but not age or sex, was predictive of amputation in multivariate analysis.

**MEDICAL RECORD REVIEW OF PATIENT CHARACTERISTICS BY RACE**

Table 3 gives detailed medical record review data for the 60 African American and 60 white patients undergoing major amputation. This review sample represented about 95% of African American and 69% (randomly selected) of all white above- and below-knee amputees treated from 1995 to 2000. The only statistically significant differences were a higher proportion of African American patients admitted with gangrene (P = .02) and with totally dependent functional status (P = .03). However, although nonsignificant in this limited sample, there were trends showing that African American amputees were more likely to be female (P = .06), and had a higher burden of illness, as indicated by higher proportions of inpatient deaths, diabetics, current smok-ers, dialysis patients, and documented terminally ill, as well as a higher mean comorbidity index.

Among the 32 patients experiencing a repeat amputation, 3 of 7 above-knee amputees had a previous above-knee procedure; all 4 of the others had previous below-knee amputations. Among the 26 below-knee amputees, 7 had previous through-foot amputations, 13 had previous below-knee procedures, and 5 had previous above-knee procedures on contralateral limbs. Table 4 and Table 5 present univariate and logistic regression data on racial differences in rates of primary and repeat amputation, controlling for age, sex, and diabetes mellitus status. Only age (but not race, sex, or diabetes mellitus status) was significant as a predictor of primary amputation. However, repeat amputees were significantly more likely to be African American than white (66% vs 34%), after controlling for age, sex, and diabetes mellitus prevalence. African Americans were 2.5 times more likely than whites to undergo a repeat amputation (P = .04).

Poor quality and timeliness of appropriate health care are often implicitly or explicitly blamed for the racial dis-
crepancy in treatment for cardiovascular disease. Studies have documented racial variation in the use of clinically beneficial and potentially lifesaving cardiovascular surgical procedures. Among patients with coronary disease, African Americans are significantly less likely than whites to receive cardiac medications, such as aspirin or β-blockers, or to undergo coronary artery bypass grafting.

Racial disparities in amputation vs revascularization rates have been repeatedly documented by administrative data. Prospective clinical data from the National VA Surgical Quality Improvement Program on several thousand largely male veterans demonstrated that African American race and Hispanic ethnicity were more strongly predictive of amputation vs revascularization than a documented history of rest pain or gangrene; this finding was independent of the relatively higher prevalence of hypertension and diabetes mellitus among African American and Hispanic amputees. By linking administrative data with retrospectively collected clinical data on individual amputees, this study adds another piece to the puzzle. Racial differences in admission rates may be related to a higher incidence of repeat amputation, rather than to a proportionate population of individual patients.

There is a long period of disease progression that underlies any dysvascular LE amputation. Recent studies have confirmed previous observations that isolated PAD is common among African Americans. Available epidemiologic data suggest that older African American women have a higher likelihood of abnormal LE blood flow, higher fasting glucose level, and higher body mass index compared with white women. The data presented herein also indicate that African American patients had more advanced and aggressive PAD, resulting in a significantly elevated frequency of repeat amputation. It is unknown to what extent this outcome is related to less aggressive prior management of diabetes mellitus or to atherosclerosis risk factors, or whether race is simply a marker for broader social determinants of health such as income, occupation, wealth, or education.

This study was undertaken at an institution with advanced vascular surgery facilities to assess the likelihood that racial disparities in amputation rates are primarily due to a lack of appropriate medical care, whether through limited access to specialists and well-equipped hospitals or physician bias against appropriate referral.

The findings presented herein of no differences in primary amputation rates, despite a significant overall racial disparity in amputation rates, indicate that severity and progression of disease (in particular the need for multiple amputations) could account for racial disparities independent of any access problems to hospitals for vascular surgery.

There are limitations to this single-hospital study, including limited data on patients’ social support, primary care, and diabetes mellitus management at the time of admission. Race is clearly a proxy for several potentially important cultural and socioeconomic factors that need to be measured directly to improve the quality of care. However, the study hospital is a microcosm of the larger Chicago area and, as such, provides other institutions with a critical benchmark for assessing disparities in PAD outcomes. The crucial factors for treatment and prevention of ischemic events are the screening and management of risk factors in susceptible populations. Progress in improving PAD outcomes awaits culturally appropriate patient self-management programs, which can leverage the active participation of patients and their families in promoting treatment.

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