
Variation in Amputation Risk for Black Patients: Uncovering Potential Sources of Bias and Opportunities for Intervention



Sahael M Stapleton, MD, Yanik J Bababekov, MD, MPH, Numa P Perez, MD, Zhi Ven Fong, MD, MPH, Daniel A Hashimoto, MD, Keith D Lillemoe, MD, FACS, Michael T Watkins, MD, FACS, David C Chang, PhD, MBA, MPH

- BACKGROUND:** Differences in amputation rates for limb ischemia between white and black patients have been extensively studied. Our goal was to determine whether biases in provider decision-making contribute to the disparity. We hypothesized that the magnitude of the disparity is affected by surgeon and hospital factors.
- STUDY DESIGN:** Analysis of the New York Statewide Planning and Research Cooperative System database was performed for 1999 to 2014. Black and white patients with ICD9 codes for peripheral vascular disease, who received either an amputation or salvage procedure, were included. The primary endpoint was treatment choice.
- RESULTS:** We analyzed 215,480 inpatient admissions. The overall amputation rate was 38.0%, and blacks were significantly more likely to receive amputations than whites on unadjusted (42.6% vs 28.6%, $p < 0.001$), and multivariable analyses (odds ratio [OR] 1.45, 95% CI 1.31 to 1.60, $p < 0.001$). This difference was more pronounced among high total vascular volume surgeons (OR 1.74, 95% CI 1.50 to 2.00, $p < 0.001$), but not among those with low total vascular volume (OR 1.06, 95% CI 0.90 to 1.24, $p = 0.49$); high volume hospitals (OR 1.57, 95% CI 1.39 to 1.78, $p < 0.001$), but not among those with low amputation volume (OR 0.96, 95% CI 0.73 to 1.27, $p < 0.80$); and surgeons who treat fewer black patients (OR 1.58, 95% CI 1.44 to 1.73, $p < 0.001$) vs surgeons who see more black patients (OR 1.43, 95% CI 1.30 to 1.57, $p < 0.001$).
- CONCLUSIONS:** Black patients are significantly more likely to receive an amputation than a salvage procedure when presenting with significant peripheral vascular diseases. High procedural volume does not seem to reduce unequal treatment; diversity of surgeon practice does. (J Am Coll Surg 2018;226:641–650. © 2018 by the American College of Surgeons. Published by Elsevier Inc. All rights reserved.)
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Improvements in the management of vascular disease have led to advances in limb salvage interventions.¹ However, it has been well established that nonwhite patients

are more likely to receive amputation than a limb salvage procedure for ischemic vascular diseases. For example, blacks are up to 7.6 times more likely than their peers to receive lower extremity amputation, despite controlling for common patient-related and socioeconomic factors.²⁻⁴

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From the Department of Surgery, Massachusetts General Hospital, Boston, MA.

Correspondence address: Sahael M Stapleton, MD, Codman Center for Clinical Effectiveness in Surgery, Massachusetts General Hospital, 165 Cambridge St, Suite 403, Boston, MA 02114. email: SSstapleton1@partners.org

The main drivers of the disparities in amputation rates between whites and nonwhites remain unclear. To date, the literature has generally focused on patient factors such as race, sex, or insurance status⁵⁻⁷; but, these factors are ultimately unmodifiable from the provider perspective.⁸ To more effectively study health care disparities, we should shift the paradigm to study provider or system factors that may potentially modulate these disparities.

Therefore, the goal of this study is to determine the possible variability in clinical decision-making for different patients presenting to similar groups of vascular

surgeons and hospitals. We performed an observational study regarding patterns and differences in treatment choice between black and white patients. We hypothesized that intra-surgeon and intra-hospital disparities will be present, despite ongoing efforts to understand and address disparities throughout health care.

METHODS

Patient database

Analysis of the New York Statewide Planning and Research Cooperative System database (SPARCS) was performed for the years 1999 to 2014. The SPARCS database for the state of New York captures all patients and payers and collects information on patients, treatments, and providers for every emergency department admission, inpatient admission/hospital discharge, outpatient visit, and ambulatory surgical procedure.

Study population

Inclusion criteria were black and white patients 18 years old or older, with significant peripheral vascular disease, undergoing either amputation or a limb salvage procedure (eFig. 1).⁹ We considered only a patient's initial presentation for inpatient care. To adhere to our aim of studying black-white disparity, we did not include other under-represented minorities. Exclusion criteria consisted of patients who were admitted for trauma or died within 1 day of admission. Patients were identified and included using the International Classification of Diseases, Ninth Revision, Clinical Modification (ICD9-CM) diagnosis and procedure codes.¹⁰

Dependent variable and covariates

The primary outcome was treatment choice of either extremity amputations or limb salvage procedures, including endovascular and open procedures for revascularization.

Surgeon amputation volume categories were defined based on the observed distribution in SPARCS as follows: low-volume (1 to 2 cases per year), middle-volume (3 to 8 cases per year), and high-volume (>8 cases per year). Similarly, the distribution of patient racial mix (number of black patients divided by total of black and white patients) for surgeons was categorized as follows: a low-to-intermediate diversity group, including surgeons up to the 75th percentile in terms of black patients as a proportion of their practice; and a high diversity group, including surgeons above the 75th percentile.

Surgeon total volume categories were defined based on the observed distribution in SPARCS as follows: low-volume (≤ 5 cases per year), low-middle volume (6 to

22 cases per year), mid-high volume (23 to 50) cases per year, and high-volume (>50 cases per year). Similarly, the distribution of patient racial mix for surgeons was categorized as follows: a low-to-intermediate diversity group, including surgeons up to the 75th percentile in terms of black patients as a proportion of their practice; and a high diversity group, including surgeons above the 75th percentile.

Hospital amputation volume categories were defined based on the observed distribution in SPARCS as follows: low-volume (<8 cases per year), middle-low volume (8 to 22 cases per year), middle-high volume (23 to 43 cases per year), and high volume (>43 cases per year). State regions were identified and classified into 11 distinct regions, as defined in SPARCS.

Analysis

Unadjusted comparison was made using *t*-tests and chi-square. Multivariable analysis was performed, with treatment choice (amputation vs limb salvage) as the dependent variable, race as the primary covariate, and adjusting for patient demographics, comorbidities, disease severity, surgeon and hospital annual volume, and year of procedure. Difference-in-difference analyses were performed across surgeon types, hospital types, and racial diversity of patient populations, to determine possible interaction effect with the primary covariate of race. Analysis was performed in Stata, version 13.1.

RESULTS

There were 215,480 inpatient admissions, representing 136,159 unique patients, included in the analysis. The overall amputation rate was 32.0%. The majority of admissions involved males 57.2% ($n = 123,282$) and whites 75.6% ($n = 162,933$), and 65.2% ($n = 140,402$) of the population was greater than 65 years old. Nonelective cases comprised 65.3% ($n = 140,410$) of the cases. The distribution of patient demographics and other comorbidities are shown in Table 1.

On unadjusted comparison, black patients are significantly more likely than whites to receive an amputation when admitted for limb-threatening ischemia (42.6% vs 28.6%, $p < 0.001$). Black patients also present at a younger age (mean age 70 vs 66 years, $p < 0.001$), were less likely to be male (49.5% vs 59.7%, $p < 0.001$), more likely to be on Medicaid (21.5% vs 7.1%, $p < 0.001$), and undergo unplanned procedures (77.9% vs 61.2%, $p < 0.001$). Black patients also have a slight but statistically significantly higher Charlson comorbidity score (30.0% vs. 29.5%, $p = 0.015$), and are more likely to present with conditions that indicate advanced diseases,

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