

From the Eastern Vascular Society

Racial disparities after infrainguinal bypass surgery in hemodialysis patients

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ABSTRACT

Background: Peripheral arterial disease poses a significant burden in the hemodialysis (HD)-dependent population. Race is a known modifier of outcomes after surgical treatment of peripheral arterial disease. A comprehensive evaluation of the effect of race on infrainguinal bypass surgery (IBS) outcomes in HD patients is lacking. In this study, we evaluated the effects of race on long-term IBS outcomes in a large, nationally representative cohort of HD patients.

Methods: We studied all HD patients who underwent IBS between January 2007 and December 2011 in the United States Renal Disease System-Medicare matched database. Univariate methods were used to compare patients' demographic and medical characteristics. Kaplan-Meier, univariate and multivariable logistic, and Cox regression analyses were used to evaluate long-term graft patency, limb salvage, and mortality.

Results: There were 9305 IBSs performed in 5188 white (56%), 3354 black (36%), and 763 Hispanic (8%) patients. Of these, 4531 (49%) were femoral-popliteal, 3173 (34%) were femoral-tibial, and 1601 (17%) were popliteal-tibial bypasses. Comparing whites vs blacks vs Hispanics, acute graft failure was 14% vs 16% vs 15% ($P = .03$), with no statistical difference on multivariate analyses. Primary patency was 52% vs 45% vs 48% at 1 year and 24% vs 21% vs 26% at 4 years ($P < .001$). Primary assisted patency was 56% vs 48% vs 53% at 1 year and 29% vs 25% vs 32% at 4 years ($P < .001$); secondary patency was 65% vs 56% vs 60% at 1 year and 40% vs 33% vs 40% at 4 years ($P < .001$). Limb salvage was 68% vs 60% vs 62% at 1 year and 45% vs 42% vs 40% at 4 years ($P < .001$). Black patients had higher long-term graft failure (adjusted hazard ratio [aHR], 1.14; 95% confidence interval [CI], 1.05-1.24; $P = .001$) and limb loss (aHR, 1.27; 95% CI, 1.15-1.40; $P < .001$) compared with white patients. No differences in graft failure (aHR, 0.99; 95% CI, 0.89-1.11; $P = .89$) and limb loss (aHR, 1.08; 95% CI, 0.94-1.23; $P = .28$) were found in Hispanics vs whites. All-cause mortality was lower among blacks (aHR, 0.65; 95% CI, 0.60-0.71; $P < .001$) and Hispanics (aHR, 0.67; 95% CI, 0.59-0.75; $P < .001$) compared with whites.

Conclusions: This large study confirms the presence of multidirectional racial disparities in graft durability, limb salvage, and mortality after IBS in HD patients. Black patients had lower graft patency and higher limb loss than white and Hispanic patients, whereas perioperative and long-term mortality was higher in white patients. These results should inform further granular root cause analyses and subsequent action to eliminate these disparities. (J Vasc Surg 2017;■:1-12.)

Peripheral arterial disease (PAD) poses a significant health burden in the population dependent on hemodialysis (HD). Recent reports estimate the prevalence of PAD in HD patients at 40% and an upward trend is anticipated.¹ Critical limb ischemia and its complications is one of the leading causes of death in this population of patients.² Consequently, HD patients comprise nearly

10% of all patients who require lower extremity revascularization in the United States (U.S.).³ This is significant, considering that patients with end-stage renal disease (ESRD) constitute only 0.2% of the U.S. population.⁴

HD patients are known to be at high risk for surgery, and the relatively poor outcomes in these patients attract significant efforts at outcomes improvement.⁵ By limiting exposure to surgery, strict patient selection has historically been considered a viable approach to minimize risk and optimize outcomes in this population.^{6,7} However, anecdotal evidence suggests that outcomes in HD patients remain relatively poor even in the most select of cases.

Racial disparities have been described in the incidence of PAD, outcomes of infrainguinal bypass surgery (IBS) in non-HD patients, and non-PAD-related vascular surgery performed in HD patients.⁸⁻¹³ However, a comprehensive evaluation of disparities in short- and long-term outcomes after IBS across racial categories in a nationally representative cohort of HD patients is lacking. The higher risk profile of dialysis patients and the unique

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biologic milieu conferred by HD dependence necessitates dedicated evaluation. Prior studies have been limited by small sample sizes or sources from single institutions and have not provided delineation of outcomes across racial categories.^{6,14-18} Hence, the extent to which patient-identified race contributes to poor outcomes in HD patients who undergo IBS is not described.

Nationwide efforts are underway to address racial disparities in health care. Successful endeavors in this direction must begin with the identification of these disparities and unbiased assessment of the magnitude in differences. Hence, the objective of this study was to examine the effects of race on long-term IBS outcomes in a nationally representative HD cohort. Furthermore, this study evaluated population-based factors that affect outcomes across racial groups and identified targets for more granular evaluation and intervention.

METHODS

The Johns Hopkins Institutional Review Board approved this study. The need for individual patient consent was waived because the study used deidentified data obtained from a publically available database.

Study cohort. A retrospective analysis was performed of all patients in the U.S. Renal Data System (USRDS) who underwent open IBS between January 2007 and December 2011. The USRDS maintains a prospective database of all ESRD patients receiving renal-replacement therapy in the U.S. Annual reports published since 1988 are available (<https://www.usrds.org/>) and provide information on epidemiology, hospitalization, mortality, and cost, among other parameters.⁴ The USRDS database robustly integrates patient-specific data from the Centers for Medicare and Medicaid Services (CMS), Centers for Disease Control and Prevention, United Network for Organ Sharing, and ESRD networks.

By linking the USRDS and Medicare claims databases, the USRDS-Medicare matched database provides longitudinal data on events related to HD and non-HD care. The IBS cohort within the USRD-Medicare matched database was identified using Current Procedural Terminology (CPT; American Medical Association, Chicago, Ill) codes for femoral-popliteal, femoral-tibial, and popliteal-tibial bypass: 35556, 35566, 35570, 35571, 35583, 35585, 35587, 35656, 35666 and 35671.

Patients' data on race and other demographic and medical characteristics were collected from CMS Form 2728, "End Stage Renal Disease Medical Evidence Report." Patients were classified based on self-identified race and ethnicity as reported to providers at the health facilities. Patients self-identifying as Native American, Asians, and "other" were excluded owing to small group size (combined n = 134) and inadequate statistical power.

ARTICLE HIGHLIGHTS

- **Type of Research:** Retrospective review of prospectively collected data of the United States Renal Disease System-Medicare matched database
- **Take Home Message:** This study found that in 9305 patients with end-stage renal disease undergoing limb revascularization, blacks had decreased secondary graft patency (33% vs 40%) and limb salvage (42% vs 45%) compared with whites at 4 years. Conversely, survival was lower in whites (15%) compared with blacks (30%) and Hispanics (33%) at 4 years.
- **Recommendation:** This study suggests that there are racial disparities in outcomes in end-stage renal disease patients who require lower extremity revascularization.

Longitudinal follow-up data were obtained from the Medicare Institutional Claims database. Data on patient mortality were collected from CMS Form 2746, "ESRD Death Notification Form." To maximize alignment of treatment and outcomes, we restricted our analyses to patients with only one IBS in the study period.

Study outcomes. The outcomes of this study were primary patency, primary assisted patency, secondary patency, limb salvage, and mortality. Primary, primary assisted, and secondary patencies were defined in accordance with Society for Vascular Surgery reporting standards.¹⁹ Acute graft failure was defined as the need to intervene ≤ 30 days of bypass surgery. Similarly, acute limb loss and graft infection were defined as amputation and excision of infected grafts ≤ 30 days of surgery. The following postoperative interventions were identified using their respective CPT codes: angioplasty (37224-37235), thrombectomy (35875, 35876, 34201, 34203, 37184-37188), revision, open exploration, repair (35879, 35881, 35883, 35884, 34421, 34451, 35721, 35741, 35860, 35226, 35256, 35286), and major limb amputation (27590, 27591, 27592, 27598, 27880, 27881, 27882, 27888, 27889). Infected grafts were identified by CPT codes for grafts excised as a result of infection (35903).

Statistical methods. Outcomes for HD patients undergoing IBS were compared across categories of white, black and Hispanic race. Descriptive analyses of the study groups were performed using χ^2 and Student *t*-tests as appropriate. Kaplan-Meier and log-rank tests were applied to compute unadjusted estimates of the long-term outcomes over time. To adjust for baseline risk, multivariable logistic and Cox regression analyses were used to compare outcomes between the study groups. Eligible patients were censored on the date of death, date of kidney transplant, or at the end of the study.

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