

# Racial disparities in outcomes after intact abdominal aortic aneurysm repair

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## ABSTRACT

**Objective:** We aimed to compare perioperative morbidity and mortality and late survival among black, white, and Asian patients undergoing intact abdominal aortic aneurysm (AAA) repair.

**Methods:** We identified all patients undergoing intact, infrarenal AAA repair in the Vascular Quality Initiative (VQI) from 2003 to 2017. We compared in-hospital outcomes by race using the Fisher exact and Kruskal-Wallis tests. Multivariable logistic and linear regression models of perioperative outcomes adjusted for differences in demographics, comorbidities, hospital volume, and procedure. We used Cox regression to evaluate late survival by race.

**Results:** In the cohort, 21,961 (94%) patients were white, 1215 (5.2%) were black, and 318 (1.4%) were Asian. Black patients were more likely to be symptomatic (black, 16%; white, 9.1%; Asian, 11%;  $P < .001$ ) and to undergo endovascular aneurysm repair (EVAR; black, 87%; white, 83%; Asian, 84%;  $P < .001$ ). There were no differences in 30-day mortality after EVAR (black, 1.1%; white, 1.1%; Asian, 0.8%;  $P = .80$ ) or open repair (black, 4.3%; white, 2.6%; Asian, 1.9%;  $P = .33$ ). However, black patients were more likely to receive new postoperative dialysis (black, 1.6%; white, 0.8%; Asian, 0.7%;  $P = .01$ ) and to return to the operating room (black, 4.3%; white, 2.9%; Asian, 0.9%;  $P < .01$ ). Mean hospital length of stay was longer in black patients after EVAR (black, 3.3 days; white, 2.6 days; Asian, 2.6 days;  $P < .001$ ) and in Asian and black patients after open repair (black, 10.5 days; white, 8.5 days; Asian, 13.0 days;  $P < .001$ ). After multivariable adjustment, black patients were more likely than white patients to have postoperative dialysis (odds ratio, 2.2; 95% confidence interval [CI], 1.3-3.6;  $P < .01$ ) and return to the operating room (odds ratio, 1.6; 95% CI, 1.2-2.2;  $P < .01$ ). Five-year survival was highest for Asian patients (black, 84%; white, 85%; Asian, 92%), even in the adjusted Cox model (Asian: hazard ratio, 0.6; 95% CI, 0.4-0.97;  $P = .04$ ).

**Conclusions:** Although perioperative mortality is comparable across races after AAA repair, black patients are more likely than white or Asian patients to develop new postoperative renal failure and return to the operating room, even after adjusting for differences in comorbidities, operative variables, and hospital volume. In addition, whereas Asian patients have the highest rate of postoperative myocardial infarction, they also have the highest late survival. Further studies are warranted to elucidate the mechanism of these disparities. (J Vasc Surg 2017;■:1-9.)

Racial disparities in surgical outcomes are well documented, including disparities after abdominal aortic aneurysm (AAA) repair.<sup>1-3</sup> Whereas the prevalence of AAA is lower in black compared with white patients, black patients have been repeatedly found to have worse outcomes after repair.<sup>4-6</sup> Several early series using the

Veterans Affairs National Surgical Quality Improvement Program data,<sup>7</sup> the Nationwide Inpatient Sample,<sup>8</sup> and Medicare<sup>2</sup> all identified higher rates of perioperative mortality in black patients compared with white patients after open AAA repair on unadjusted analyses. However, these disparities were often mitigated, at least in part, by adjusting for patient demographics, including socioeconomic status, and comorbid conditions.

More recent studies have focused on the interplay between race, socioeconomic status, and hospital quality and have found that black patients more often receive care in low-volume hospitals<sup>8</sup> and that hospitals treating large proportions of black patients have higher mortality for all patients, including their nonblack patients.<sup>2</sup> Osborne et al<sup>9</sup> found that black patients had a higher mortality after AAA repair and that 29% of the disparity was related to comorbidities of the patient, 26% to socioeconomic factors, and 25% to lower hospital quality. They additionally found that black patients less often underwent endovascular aneurysm repair (EVAR), even after adjusting for procedure urgency and characteristics of the patients.<sup>10</sup> Notably, however, these studies used data from Medicare beneficiaries undergoing intervention between 2001 and 2006, with only one-third to

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one-half of patients undergoing EVAR. In the modern era, >80% of infrarenal AAA repairs are performed through an endovascular approach, and hospital and surgeon volumes have less of an effect on perioperative outcomes.<sup>11</sup> Furthermore, few studies have evaluated outcomes in other minority ethnic groups, including Asian patients. Whereas Asians make up a minority of patients undergoing AAA repair, small series have described shorter, more tortuous iliac arteries in Asian patients, and this may have an impact on procedural complexity and therefore outcomes.<sup>12-14</sup>

We recently used the Society for Vascular Surgery Vascular Quality Initiative (VQI) registry to describe racial differences in presentation for an initial vascular procedure.<sup>15</sup> We found that black patients more often presented with symptomatic or ruptured aneurysm, which may represent barriers to appropriate screening and referral to a specialist and would certainly contribute to worse outcomes overall. However, the impact of race on outcomes after repair of intact aneurysms in the modern era is less clear. Furthermore, few studies have evaluated perioperative outcomes other than mortality. Therefore, the goal of this study was to expand on our previous analysis by using the VQI to compare perioperative morbidity and mortality and late survival among black, white, and Asian patients undergoing intact AAA repair.

## METHODS

The Beth Israel Deaconess Medical Center Institutional Review Board approved this study and waived informed consent because of the use of deidentified data in the VQI.

**Population.** We performed a retrospective cohort study using the Society for Vascular Surgery VQI, a national clinical registry established as a collaboration between regional quality groups to improve patient care through the prospective collection of clinical data. At the time of this study, the VQI included 17 regions and close to 400 participating hospitals. Within participating hospitals, complete capture of all included procedures is expected, with regular performance reviews to ensure compliance. More information about the VQI can be found at [www.vascularqualityinitiative.org](http://www.vascularqualityinitiative.org). We identified all patients undergoing open or endovascular repair of an infrarenal AAA between 2003 and January 2017 and excluded those with rupture or those with missing race data or race other than white, black, or Asian ( $n = 818$  [3.4%]). Patients with missing race data or race other than white, black, or Asian were more often treated with open repair (20% vs 17%;  $P = .04$ ) and at low-volume hospitals (52% vs 37%;  $P < .001$ ) and had slightly lower rates of chronic obstructive pulmonary disease, coronary artery disease, congestive heart failure, and chronic kidney disease (all  $P < .05$ ). Hispanic ethnicity was coded separately, with

## ARTICLE HIGHLIGHTS

- **Type of Research:** Retrospective analysis of prospectively collected Vascular Quality Initiative (VQI) data
- **Take Home Message:** Among 21,961 patients who underwent elective abdominal aortic aneurysm repair using open or endovascular techniques, there were no racial disparities in early mortality, but black and Asian patients had higher early morbidities. Five-year survival was highest, 92%, for Asian patients.
- **Recommendation:** This study suggests that there are no racial disparities in 30-day mortality after endovascular aneurysm repair or open abdominal aortic aneurysm repair, but blacks and Asians have more perioperative morbidity, and Asians have the highest 5-year survival.

Hispanic and non-Hispanic white patients grouped together and Hispanic and non-Hispanic black patients grouped together, given the low percentage of Hispanic patients. Race and ethnicity were coded by the treating provider at each hospital who enters demographic data, which in many cases comes from how patients self-identify.

**Variables.** Demographics, comorbid conditions, operative details, and in-hospital postoperative outcomes were identified for all patients. We used the standard formula for body mass index, weight (kg)/height (m<sup>2</sup>), and a single preoperative creatinine value to estimate the glomerular filtration rate for each patient using the Modification of Diet in Renal Disease study equation, which accounts for the patient's sex and race.<sup>16</sup> Renal insufficiency was considered present with an estimated glomerular filtration rate of <30 mL/min/1.73 m<sup>2</sup> or current dialysis. We defined preoperative anemia as hemoglobin level <10 g/dL.

Hospital volume was calculated using deidentified center identification numbers from the VQI, and it was calculated separately for each center's open and endovascular volume in the prior year, with low-volume hospitals for the respective procedures defined as those performing <18 open cases or <30 endovascular cases, per our prior work.<sup>11</sup> Prior aneurysm repair included open or endovascular repair of any aortic aneurysm, and prior AAA repair was noted separately. The VQI defined aortic diameter as the maximum total aortic diameter within the diseased segment being treated. Symptomatic patients were those presenting with symptoms but without rupture, as defined by the VQI. Concomitant procedures during EVAR included hypogastric coiling (preoperative or intraoperative), unplanned graft extension, femoral endarterectomy, iliofemoral bypass, thrombectomy, iliac angioplasty or stent

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