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The impact of race and ethnicity on the outcome of carotid interventions in the United States

Eric B. Schneider, PhD,[a,b] James H. Black III MD,[a] Hali L. Hambridge, BS,[b]
Ying Wei Lum, MD,[a] Julie A. Freischlag, MD,[a] Bruce A. Perler, MD,[a] and
Christopher J. Abularrage, MD[a,*]

[a] Division of Vascular Surgery and Endovascular Therapy, The Johns Hopkins Hospital, Harvey 611, 600 N Wolfe Street,
Baltimore, Maryland 21287
[b] Center for Surgical Trials and Outcomes Research, The Johns Hopkins Hospital, Baltimore, Maryland

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ABSTRACT

Objective: Previous studies have demonstrated an adverse impact of African American race and Hispanic ethnicity on the outcomes of carotid endarterectomy (CEA), although little is known about the influence of race and ethnicity on the outcome of carotid angioplasty and stenting (CAS). The present study was undertaken to examine the influence of race and ethnicity on the outcomes of CEA and CAS in contemporary practice.

Methods: The nationwide inpatient sample (2005−2008) was queried using International Classification of Diseases-9 codes for CEA and CAS in patients with carotid artery stenosis. The primary outcomes were postoperative death or stroke. Multivariate analysis was performed adjusting for age, gender, race, comorbidities, high-risk status, procedure type, symptomatic status, year, insurance type, and hospital characteristics.

Results: Overall, there were 347,450 CEAs and 47,385 CASs performed in the United States over the study period. After CEA, Hispanics had the greatest risk of mortality ($P < 0.001$), whereas black patients had the greatest risk of stroke ($P = 0.02$) compared with white patients on univariate analysis. On multivariable analysis, Hispanic ethnicity remained an independent risk factor for mortality after CEA (relative risk 2.40; $P < 0.001$), whereas the increased risk of stroke in black patients was no longer significant. After CAS, there were no racial or ethnic differences in mortality. On univariate analysis, the risk of stroke was greatest in black patients after CAS ($P = 0.03$). However, this was not significant on multivariable analysis.

Conclusion: Hispanic ethnicity is an independent risk factor for mortality after CEA. While black patients had an increased risk of stroke after CEA and CAS, this was explained by factors other than race. Further studies are warranted to determine if Hispanic ethnicity remains an independent risk factor for mortality after discharge.

1. Introduction

Carotid endarterectomy (CEA) has long been the standard of care for the treatment of high-grade carotid artery stenosis. Data from randomized trials have shown a decrease in the risk of stroke in both symptomatic [1,2] and asymptomatic [3,4] patients treated with CEA compared with those treated with medical therapy alone.

More recently, carotid angioplasty and stenting (CAS) has been purported as an alternative treatment of carotid occlusive disease. Data from the carotid revascularization endarterectomy versus stenting trial (CREST) trial found no difference in the risk of the composite outcome of stroke, myocardial infarction, or death in symptomatic or asymptomatic patients undergoing CEA or CAS [5]. There was a higher risk of stroke in patients undergoing CAS over the 4-y study period. Despite this, administrative database reviews have found an increase in the utilization of CAS in the United States [6].

Racial and ethnic disparities are known to exist in medical care [7]. Patients with low socioeconomic status are more likely to receive an amputation for critical limb ischemia [8]. Furthermore, black patients with symptomatic carotid artery stenosis have increased postoperative all-stroke rates compared with white patients [9]. The increased rate of stroke or myocardial infarction after CEA in black patients may be because of the fact that these patients are more likely to undergo surgery at lower CEA volume hospitals [10].

Studies of New York state Medicare beneficiaries undergoing CEA suggest that minorities have inferior outcomes and higher rates of inappropriate surgery [11]. This difference could be explained by increased comorbidities and provider characteristics in black patients but not in Hispanics. No studies to date have examined racial disparities associated with CAS.

Therefore, the goal of this study was to examine the influence of race and ethnicity on the outcomes of carotid interventions on a national level.

2. Methods

The nationwide inpatient sample (NIS) provided by the Healthcare Cost and Utilization Project, Agency for Healthcare Research and Quality, was queried for CEA and CAS in patients with a diagnosis of carotid artery stenosis during the calendar years 2005–2008. CEA and CAS were identified by the International Classification of Diseases Ninth Revision, Clinical Modification (ICD-9CM) procedure codes 38.12 and 00.63, respectively. Race is defined in the NIS as white, black, Hispanic, Asian or Pacific Islander, Native American, or Other. Exclusion criteria included age less than 18 y or greater than 99 y, patients undergoing concurrent coronary artery bypass grafting, and patients without a concomitant diagnosis of carotid artery stenosis (ICD-9CM 433.10, 433.11, 433.30, and 433.31). Patients whose race was coded separately as Asian or Pacific Islander, Native American, or other were excluded because of small numbers and the resulting inaccuracy of

statistical analysis. This study was approved by the Johns Hopkins Hospital Institutional Review Board.

Preoperative patient characteristics were analyzed, including age, sex, comorbidities, clinical presentation (symptomatic or asymptomatic), and high-risk status. Patients were classified as symptomatic if they carried a diagnosis of amaurosis fugax (ICD-9CM 362.34 and 368.12), transient ischemic attack (TIA, ICD-9CM 435.9 and 781.4), or stroke (ICD9-CM 433.11, 433.31, 433.91, 434.01, 434.11, and 434.91). Patients were alternatively considered symptomatic if they carried a discharge diagnosis of carotid artery stenosis with infarction (ICD-9CM 433.11) or carotid artery stenosis without infarction (ICD-9CM 433.10) but with an accompanying diagnosis of TIA [12]. Patients were considered high risk if they met the criteria of Giles *et al.* [13].

Hospital characteristics, including teaching hospital status and size were included for analysis. Hospital size was divided into small, medium, and large by the Healthcare Cost and Utilization Project based on their in-house criteria. Primary insurance payer was defined as private/Medicare *versus* Medicaid/self-pay/no charge. Hospital location was divided into rural *versus* urban, and hospital region was divided into northeast, midwest, south, and west.

Primary outcomes were in-hospital postoperative stroke (ICD-9CM 997.02) and death. Postoperative death was defined as death occurring during the same hospital stay regardless of the postoperative interval. Secondary outcomes included postoperative myocardial infarction or cardiac complications (ICD-9CM 997.1).

The data were weighted to approximate the national population in accordance with methods specified for use of the NIS. Univariate analysis was performed using student's t-tests and Wilcoxon rank sum tests for continuous variables and chi-square tests for dichotomous and categorical variables.

Multivariate regression analysis was performed adjusting for age, gender, race, comorbidities (Charlson index), high-risk status, procedure type, symptomatic status, year, insurance type, and hospital characteristics. The possibility of correlation between high-risk status and underlying medical comorbidity was examined using the nonparametric Spearman correlation coefficient, and it was determined by consensus that membership in the high-risk group was more meaningful clinically than the Charlson index score, which would be excluded from regression models if the two were correlated. All relationships presented in tables are based on actual data except relative risks (RRs), which were calculated using data weighted to approximate the population.

3. Results

Overall, there were 347,450 CEAs and 47,385 CASs performed from 2005–2008 in the United States. CEA was performed in 320,485 white patients, 12,775 black patients, and 14,190 Hispanic patients. CAS was performed in 42,990 white patients, 2,075 black patients, and 2,320 Hispanic patients.

There were multiple differences among racial and ethnic groups in terms of age, sex, and comorbidites (Table 1). Black patients (12.1% CEA/18.8% CAS) and Hispanics (12.1% CEA/