Obesity is an Independent Risk Factor for Death and Cardiac Complications after Carotid Endarterectomy

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BACKGROUND: The role of obesity as a risk factor after carotid endarterectomy is not well-described. We undertook a study of the association of obesity with 30-day outcomes after carotid endarterectomy.

STUDY DESIGN: After obtaining Institutional Review Board approval, we retrospectively analyzed prospectively collected data from carotid endarterectomies in the 2005−2006 Veterans Affairs Surgical Quality Improvement Program database. The association of body mass index (BMI; calculated as kg/m^2) on 30-day outcomes was assessed using multivariable logistic regression.

RESULTS: From 3,706 carotid endarterectomies, we excluded 22 for missing BMI and 39 for emergency status; 3,645 carotid endarterectomies were analyzed. BMI was underweight (<18.5) in 1.6%, normal (18.5 to 24.9) in 31.0%, overweight (25.0 to 29.9) in 40.8%, class I obese (30.0 to 34.9) in 19.3%, class II obese (35.0 to 39.9) in 5.8%, and class III obese (≥40) in 1.6%. On multivariable analysis, class II to III (odds ratio = 6.95; 95% CI, 1.89−25.58; p = 0.004) obesity was associated with death, and class II to III obesity was associated with cardiac complications (odds ratio = 3.68; 95% CI, 1.27−10.66; p = 0.02) compared with normal weight.

CONCLUSIONS: Obesity is an independent risk factor for death and cardiac complications after carotid endarterectomy. Surgeons should consider this when evaluating the risks and benefits of carotid endarterectomy in obese patients. Carotid artery stenting was not assessed, and future studies are needed to examine its role in management of obese patients. (J Am Coll Surg 2012;214: 148–155. © 2012 by the American College of Surgeons)

During the past 50 years, the age-adjusted prevalence of obesity in the US adult population has increased dramatically, from 13.4% in 1960 to 33.9% in 2008.[1,2] Beyond the United States, obesity poses a worldwide public health challenge, accounting for 7% of all diseases in developed countries[3] and as much as 10% to 13% of deaths throughout Europe.[4]

Obesity has been identified as a risk factor for multiple vascular pathologies, including coronary artery disease,[5,6] carotid atherosclerosis and stroke,[7,8] peripheral arterial disease,[9,10] and abdominal aortic aneurysm (AAA).[11] In recent years, several studies have examined the association of obesity with outcomes after vascular surgery. We previously reported an association between obesity and increased mortality after open and endovascular AAA repair.[12] Giles and colleagues also reported a relationship between morbid obesity and increased mortality after open and endovascular AAA repair[13] and lower-extremity bypass.[14] However, the influence of obesity on perioperative outcomes after carotid endarterectomy is not well-described.

Understanding the relationship of obesity to outcomes after carotid endarterectomy is critical because appropriate patient selection depends on accurate assessment of the risks and benefits of carotid endarterectomy in an individual patient. In the 1990s, the North American Symptomatic Carotid Endarterectomy Trial (NASCET) and Asymp-

tomatic Carotid Atherosclerosis Study (ACAS) established carotid endarterectomy over best medical management, as defined at the time of the study as the treatment of choice for ≥50% symptomatic carotid stenosis and ≥60% asymptomatic stenosis, respectively,[15-17] For 50% to 69% symptomatic stenosis and ≥60% asymptomatic stenosis, carotid endarterectomy was found to afford a relative benefit only if perioperative rates of disabling stroke and death are maintained ≤2% to 3%.[16,17] In a 2004 US multistate audit, however, the procedural risk of stroke and death for asymptomatic carotid stenosis was found to be 3.8%.[18] This might partly reflect deficiencies in operative and postoperative care, but some of the excess complications doubtless result from inappropriate selection of high-risk patients for prophylactic carotid endarterectomy. For asymptomatic patients with advanced age or substantial comorbidities, the risks of carotid endarterectomy probably outweigh the benefits.[19] However, which comorbidities increase the risk of death and complications after carotid endarterectomy is not well-described, and definitions of high-risk patients are neither evidence-based nor universally accepted.[20] Understanding the influence of patient characteristics, such as obesity, on perioperative risk is crucial for appropriate patient selection and optimization for carotid endarterectomy.

We undertook a study to examine the association of obesity with 30-day postoperative morbidity and mortality after carotid endarterectomy.

METHODS

Database
We undertook a retrospective analysis of prospectively collected data from the Veterans Affairs Surgical Quality Improvement Program (VASQIP). VASQIP is an ongoing quality-management initiative designed to measure and enhance the quality of surgical care at VA hospitals. All 123 VA Medical Centers that perform major surgery participate in the VASQIP. Trained nurse reviewers prospectively collect preoperative, operative, and postoperative data from concurrent chart review, physician interview, and patient

Table 1. Inclusion Criteria

Code	Description
CPT code	
35301	Thromboendarterectomy, with or without patch graft; carotid, vertebral, subclavian, by neck incision
ICD-9 diagnosis codes	
433.1	Occlusion and stenosis of precerebral arteries, carotid artery
433.10	Occlusion and stenosis of precerebral arteries, carotid artery; without mention of cerebral infarction
433.11	Occlusion and stenosis of precerebral arteries, carotid artery; with cerebral infarction

CPT, current procedural terminology.

follow-up. Patient outcomes are assessed 30 days postoperatively and deaths are verified against the VA Beneficiary Identification and Records Locator System death records.[21]

The Washington, DC VA Medical Center Institutional Review Board approved this study.

Sample selection
We included all carotid endarterectomy procedures, defined by CPT code 35301 plus ICD-9 postoperative diagnosis code 433.1, 433.10, or 433.11 (Table 1), from January 1, 2005 through December 31, 2006. Because CPT code 35301 includes thromboendarterectomy of the vertebral and subclavian arteries, ICD-9 codes 433.1–11 were used to restrict the analysis to carotid procedures.

We excluded procedures for which patient height or weight data were not available. Emergency procedures were excluded because it was believed that a separate analysis would be most appropriate for these cases, and there were too few cases to perform such an analysis. Carotid endarterectomies performed with simultaneous coronary artery bypass graft (CPT 33510, 33511, 33512, 33513, 33514, 33515, 33516, 33517, 33518, 33519, 33521, 33522, 33523, 33530, 33533, 33534, 33535, 33536, 33542, or 33545) were excluded.

All patient identifiers were stripped from the database used for analysis by the VA SQIP database steward.

Obesity definition
BMI (calculated as weight in kg divided by height in m^2) was determined from each patient's preoperative weight and height variables. BMI was categorized using the National Institutes of Health definition[22] as underweight (BMI <18.5), normal weight (BMI 18.5 to 24.9), overweight (BMI 25.0 to 29.9), class I obese (BMI 30.0 to