An update on the incidence of perioperative outcomes after carotid endarterectomy, stratified by type of preprocedural neurologic symptom

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ABSTRACT

Objective: Perioperative complications after carotid endarterectomy (CEA) have decreased over time. Therefore, we aimed to provide an update on 30-day outcomes after CEA, stratified by type of preprocedural neurologic symptom.

Methods: We included all CEAs from the Targeted Vascular module of the American College of Surgeons National Surgical Quality Improvement Program (ACS-NSQIP, 2011-2015) and stratified patients based on type of preprocedural neurologic symptom, that is, asymptomatic, ocular transient ischemic attack (TIA), hemispheric TIA, and stroke. We compared 30-day outcomes across the groups, with 30-day stroke/death as our primary endpoint.

Results: Of 16,739 CEA patients, 9784 were asymptomatic (58%). Among the 6955 symptomatic patients, 1216 (17%) had a preprocedural ocular TIA, 2635 (38%) a preprocedural hemispheric TIA, and 3104 (45%) a preprocedural stroke. Preprocedural stroke patients had higher 30-day stroke/death rates compared with those with a preprocedural hemispheric TIA, or ocular TIA, or asymptomatic patients (5.0% vs 3.3%, 1.9%, and 1.8%, respectively; all $P < .001$), primarily owing to differences in perioperative 30-day stroke rates, with 4.1% vs 2.5%, 1.4%, and 1.3%, respectively (all $P < .001$).

Conclusions: Among symptomatic CEA patients, those with a preprocedural stroke had a high perioperative 30-day stroke/death rate, compared with those patients with either a preprocedural hemispheric or ocular TIA. Therefore, the common stratification applied to CEA patients, which groups all symptomatic patients, should be avoided, especially as the relative proportion of symptomatic patients with a preprocedural stroke vs those with a hemispheric or ocular TIA will affect the overall outcome for all symptomatic patients after CEA. (J Vasc Surg 2018;67:785-92.)

The goal of carotid endarterectomy (CEA) is to prevent future stroke and death related to carotid artery disease. Although routinely performed since the 1950s, the North American Carotid Endarterectomy Trial (NASCET) and the Asymptomatic Carotid Atherosclerosis Study (ACAS) first established the benefit of CEA over best medical treatment in stroke prevention.[1-3] However, since the publication of these trials, perioperative complication rates after CEA have decreased and medical treatment has improved, in part owing to use of statins.[4-11] Therefore, it is unclear how applicable these pivotal trials still are today.

The upcoming Carotid Revascularization and Medical Management for Asymptomatic Carotid Stenosis Trial (CREST-2) will compare CEA with current best medical management. However, results from randomized controlled trials (RCTs) are not always generalizable to the broader clinical practice, owing to restrictive inclusion and exclusion criteria and experience-based requirements for randomizing surgeons. Therefore, reassessment of outcomes after CEA in the modern era, as performed in a real-world setting is necessary to provide reference for upcoming RCTs.

Moreover, owing to the introduction of performance-based payment adjustments in Medicare, surgeons could lose up to 9% of their annual reimbursements by 2020, if they have above average complication rates,[12] in addition to any reputational damage, because physicians' scores will be published each year and made accessible to the public. Therefore, it is vital to provide surgeons and both government and reporting agencies with a more granular understanding of perioperative outcomes after CEA, stratified on type of preprocedural neurologic symptom. Especially because, among CEA patients, the proportion of patients with a preprocedural stroke will likely affect perioperative stroke/death rates after CEA for all patients; those with a preprocedural stroke have a higher risk of adverse events after CEA, compared with those with a preprocedural transient ischemic attack (TIA) or asymptomatic patients.

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S.E.D. and T.F.X.O. are supported by the Harvard-Longwood Research Training in Vascular Surgery NIH T32 Grant 5T32HL007734-22.

Author conflict of interest: none.

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The editors and reviewers of this article have no relevant financial relationships to disclose per the JVS policy that requires reviewers to decline review of any manuscript for which they may have a conflict of interest.

0741-5214

https://doi.org/10.1016/j.jvs.2017.07.132

Therefore, we aimed to provide an update on perioperative outcomes after CEA using national data from 2011 to 2015, stratified by type of preprocedural neurologic symptom (ie, ocular or hemispheric TIA, stroke, and asymptomatic), using the Targeted Vascular module of the American College of Surgeons National Surgical Quality Improvement Program (ACS-NSQIP) registry.

ARTICLE HIGHLIGHTS

- **Type of Research:** Retrospective analysis of the targeted vascular module of the American College of Surgeons National Surgical Quality Improvement Program (ACS-NSQIP) database
- **Take Home Message:** After 16,739 carotid endarterectomies (CEAs) those with pre-CEA stroke had higher 30 day stroke/death and stroke rates (5.0% and 4.1%) than those with pre-CEA transient ischemic attack (TIA; 3.3% and 2.5%) or ocular TIA (1.9% and 1.4%) or asymptomatics/asymptomatic patients (1.8% and 1.3%).
- **Recommendation:** This study suggests that patients with a recent history of stroke have a significantly higher risk of stroke at 30 days after CEA than those with hemispheric TIA or ocular TIA. Thus, outcomes after CEA for symptomatic patients should be stratified based on type of preprocedural neurologic symptoms.

METHODS

Registry. The ACS-NSQIP clinical registry had 603 participating hospitals in 2015 and captured data on more than 270 predefined variables, including perioperative complications up to 30 days. Each procedure was entered into the registry based on its Current Procedural Terminology code to enable categorization. Participating hospitals assigned trained surgical clinical reviewers to collect data from medical charts and operative case logs using strict variable definitions to maintain uniformity. To ensure complete follow-up, patients were contacted at 30 days after the index procedure by letters or phone calls, if necessary. Additionally, the ACS-NSQIP performed random reliability auditing to minimize selection bias.

In the Targeted Vascular Module of the ACS-NSQIP, a subset of participating hospitals (89 in 2015) captured additional disease- and procedure-specific patient characteristics and outcomes, chosen by vascular surgeons. The reliability and quality of data collection in the ACS-NSQIP has been validated by prior studies.[13,14] Further details on the ACS-NSQIP registry can be found at www.facs.org/quality-programs/acs-nsqip.

The Beth Israel Deaconess Medical Center Institutional Review Board approved this project and waived the need for informed consent for the use of deidentified data.

Patient cohort. We identified all CEA patients between January 2011 and December 2015 from the Targeted Vascular module of the ACS-NSQIP. We excluded patients with missing data on preoperative symptom status (n = 346, 1.9%), those undergoing concurrent cardiac surgery (n = 22, 0.1%), emergency cases (n = 459, 2.5%), and patients with preprocedural ipsilateral carotid occlusion (n = 196, 1.1%). This resulted in a sample of 16,739 patients.

Variables. Our main explanatory variable was preoperative symptom status, which the Targeted Vascular module of the ACS-NSQIP captured as the presence of preprocedural ipsilateral neurologic symptoms, divided into four groups: (1) no symptoms, that is, asymptomatic, (2) preprocedural amaurosis fugax or transient monocular blindness, hereafter referred to as ocular TIA, (3) preprocedural hemispheric TIA, and (4) preprocedural stroke.

Preprocedural ocular TIA was defined as ipsilateral temporary blindness, lasting between 30 seconds and 24 hours in one or both eyes. The registry defined preprocedural hemispheric TIA as any ipsilateral neurologic dysfunction lasting less than 24 hours, without evidence of acute infarction, or radiologic findings indicative of cerebral infarction, performed after the onset of symptoms. Preprocedural strokes were defined as any ipsilateral motor, sensory, or cognitive dysfunction, which persisted for more than 24 hours, or when preoperative radiologic findings were indicative of cerebral infarction.

Our primary endpoint was the occurrence of any ipsilateral stroke or death within 30 days postoperatively, hereafter referred to as 30-day stroke/death. Secondary endpoints were mortality, stroke, myocardial infarction (MI), cranial nerve injury (CNI), pneumonia, unplanned reoperations, readmissions related to the index procedure, and duration of stay. The registry collected all outcomes for 30 days after the index procedure.

The targeted NSQIP defined perioperative stroke as any new acute ipsilateral neurologic dysfunction lasting more than 24 hours, or a postoperative radiologic finding indicative of new cerebral infarction. MI is defined as documentation of one or more of the after electrocardiographic changes: more than 1 mm ST elevation, Q-wave in more than two leads, or left bundle branch block, or was diagnosed in patients with a three-fold elevation of troponin levels. CNI was recorded as present in the NSQIP when the patient's medical record indicated an injury to a cranial nerve. The definition of pneumonia included signs of infiltration on radiologic imaging, combined with either clinical signs of infection or a positive throat culture or sputum. Unplanned reoperations included any unscheduled return to the operation room within 30 days after the index procedure. Readmissions related to the index procedure included any readmission within 30 days owing to a postoperative