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Preoperative symptom type influences the 30-day perioperative outcomes of carotid endarterectomy and carotid stenting in the Society for Vascular Surgery Vascular Registry

Patrick J. Geraghty, MD[a], **Thomas E. Brothers, MD**[b], **David L. Gillespie, MD**[c], **Gilbert R. Upchurch, MD**[d], **Michael C. Stoner, MD**[e], **Flora S. Siami, MPH**[f], **Christopher T. Kenwood, MS**[f], and **Philip P. Goodney, MD**[g]

[a]Division of Surgery, Vascular Surgery Section, Washington University Medical School, St. Louis

[b]Department of Surgery, Division of Vascular Surgery, Medical University of South Carolina, Charleston

[c]Southcoast Cardiovascular Surgery, Southcoast Health System, Fall River

[d]Division of Vascular and Endovascular Surgery, University of Virginia Medical School, Charlottesville

[e]Department of Cardiovascular Sciences, Vascular Surgery, East Carolina University, Greenville

[f]New England Research Institutes, Inc, Watertown

[g]Section of Vascular Surgery, Dartmouth-Hitchcock Medical Center, Lebanon

Abstract

Objective—The objective of this study was to determine the effect of presenting symptom types on 30-day periprocedural outcomes of carotid endarterectomy (CEA) and carotid artery stenting (CAS) in contemporary vascular practice.

Reprint requests: Flora S. Siami, MPH, Vice President, Clinical and Regulatory Affairs, New England Research Institutes, Inc, 9 Galen St, Watertown, MA 02472 (ssiami@neriscience.com).

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Methods—Retrospective review was undertaken of the Society for Vascular Surgery Vascular Registry database subjects who underwent CEA or CAS from 2004 to 2011. Patients were grouped by discrete 12-month preprocedural ipsilateral symptom type: stroke, transient ischemic attack (TIA), transient monocular blindness (TMB), or asymptomatic (ASX). Risk-adjusted odds ratios (ORs) were used to compare the likelihood of the 30-day outcomes of death, stroke, and myocardial infarction (MI) and the composite outcomes of death + stroke and death + stroke + MI.

Results—Symptom type significantly influences risk-adjusted 30-day outcomes for carotid intervention. Presentation with stroke predicted the poorest outcomes (death + stroke + MI composite: OR, 1.3; 95% confidence interval [CI], 0.83–2.03 vs TIA; OR, 2.56; 95% CI, 1.18–5.57 vs TMB; OR, 2.12; 95% CI, 1.46–3.08 vs ASX), followed by TIA (death + stroke + MI composite: OR, 1.97; 95% CI, 0.91–4.25 vs TMB; OR, 1.63; 95% CI, 1.14–2.33 vs ASX). For both CAS and CEA patients, presentation with stroke or TIA predicted a higher risk of periprocedural stroke than in ASX patients. Presentation with stroke predicted higher 30-day risk of death with CAS but not with CEA. MI rates were not affected by presenting symptom type. The 30-day outcomes for the TMB and ASX patient groups were equivalent in both treatment arms.

Conclusions—Presenting symptom type significantly affects the 30-day outcomes of both CAS and CEA in contemporary vascular surgical practice. Presentation with stroke and TIA predicts higher rates of periprocedural complications, whereas TMB presentation predicts a periprocedural risk profile similar to that of ASX disease.

In addition to prior completed ipsilateral stroke, hemispheric transient ischemic attack (TIA) ipsilateral to significant carotid bifurcation stenosis has long been known to predict subsequent ipsilateral stroke and excess cardiovascular mortality.[1,2] In similar fashion, transient monocular blindness (TMB, also known as amaurosis fugax) associated with carotid bifurcation stenosis foretells an elevated risk of subsequent stroke, although less than that described for TIA.[3]

The North American Symptomatic Carotid Endarterectomy Trial (NASCET) firmly established the benefit of carotid endarterectomy (CEA) for symptomatic moderate to severe carotid stenoses.[4,5] NASCET also added to our knowledge of the natural history of symptomatic carotid disease; analysis of the medical treatment arm of NASCET demonstrated a higher 2-year risk of stroke for patients presenting with hemispheric TIA (43.5% ± 6.7%) in comparison to TMB (16.6% ± 5.6%).[6] Separate examination of surgical results from NASCET showed that procedural stroke outcomes were poorer for patients presenting with hemispheric TIA rather than TMB,[7] confirming the findings of earlier investigators.[8]

Yet even as NASCET and the Asymptomatic Carotid Atherosclerosis Study[9] established the primacy of CEA for stroke reduction in symptomatic and asymptomatic lesions, early experiences with angioplasty and stent placement for carotid disease were being reported.[10,11] During the next decade, carotid artery stenting (CAS) was compared with CEA in randomized trials ranging from the Stenting and Angioplasty with Protection in Patients with High Risk for Endarterectomy (SAPPHIRE) study to the more recent and better powered Carotid Revascularization Endarterectomy vs Stenting Trial (CREST).[12,13] Both trials enrolled asymptomatic and symptomatic patients, and their publication has

provided further insight into the comparative benefits of CAS and CEA. However, neither study examined the relationship of presenting symptom type (stroke, TIA, or TMB) to procedural outcomes.

The Society for Vascular Surgery Vascular Registry (SVS-VR) carotid module collected demographic, procedural, and outcomes data from contributing centers for CEA and CAS from 2004 through 2011. By the nature of registry design, patients entered into the SVS-VR are unmatched, yet risk-adjusted data from this "real-world" experience provide valuable insight into current vascular surgical outcomes.[14] Using the SVS-VR, we sought to determine the effect of presenting symptom type on early outcomes of CEA and CAS in contemporary vascular practice.

METHODS

The derivation of 30-day periprocedural outcomes data from the SVS-VR, inclusive of procedural and predischarge data, has previously been reported.[14] All registry patients who underwent CEA or CAS with available 30-day outcomes reporting were identified. For clarity of comparison, carotid procedures undertaken for atherosclerotic, radiation-induced, or restenotic lesions of the carotid bifurcation and internal carotid artery were included, but procedures undertaken for trauma, dissection, or unspecified causes were excluded. Procedures undertaken only on the common carotid or external carotid arteries were excluded. CEA and CAS patients were grouped by discrete preprocedural ipsilateral symptom type occurring within the 12 months before intervention: stroke, TIA, TMB, or asymptomatic (ASX). Patients reporting more than one symptom (eg, TIA and stroke) were excluded from analysis. Risk-adjusted odds ratios (ORs) were used to compare the likelihood of the 30-day outcomes of death, stroke, and myocardial infarction (MI) and the composite outcomes of death + stroke and death + stroke + MI.

Statistical methods

Descriptive statistical comparisons were conducted with χ^2 tests for categorical variables and analysis of variance for continuous variables. Descriptive statistics are listed as mean ± standard deviation for continuous variables and percentage (frequency) for categorical variables. Outcomes analyses comparing across symptom groups were conducted in subsets of the cohort with the Fisher exact test for discrete/categorical data. Adjusted ORs found through multivariable logistic regression were used to compare the selected outcomes measures between the symptom-defined groups. Adjusted ORs for the multiple symptom group comparisons were adjusted for significant baseline factors that were retained after applying backwards elimination methods. Differences in multiple symptom group comparisons were considered significant if $P < .0083$ (using a Bonferroni correction factor of 6). All other differences were considered significant if $P < .05$. All statistical analyses were performed by New England Research Institute (NERI, Watertown, Mass) with SAS Statistical Software (Cary, NC).

All data entered into the SVS-VR are fully compliant with the Health Insurance Portability and Accountability Act regulations and are auditable. All data reports and analyses performed include only de-identified and aggregated data. NERI maintains the online

database, and funding for the administration and database management of the Vascular Registry has been provided by the Society for Vascular Surgery.

RESULTS

A total of 5758 CEA procedures and 2882 CAS procedures from the SVS-VR met the specified inclusion criteria. Demographics and medical history for the exclusive presenting symptom groups (Table I) reflect the heterogeneity of these unmatched registry populations. The CAS treatment group contains higher percentages of interventions for restenosis and postradiation changes than the CEA group does (Table II), consistent with this technique's ability to avoid the surgical challenges associated with the hostile or previously operated on neck. Unadjusted event rates for CAS and CEA procedures, delineated by presenting symptom type, are displayed in Table III. Although certain unadjusted event rates in Table III are compelling (such as the 11.6% periprocedural incidence of the composite death + stroke + MI in patients presenting with stroke who were treated with CAS), the unmatched nature of the enrolled CAS and CEA patient populations invalidates comparisons between the endovascular and surgical treatment groups.

After application of the stringent risk-adjusting methods described before, multiple symptom group comparisons were conducted in bivariate fashion, illuminating the effect of presenting symptom type on each of the major periprocedural outcomes measures (Tables IV and V). Of note is that 30-day outcomes of TMB and ASX presentation are indistinguishable for both CAS and CEA patients. The significant findings from Tables IV and V regarding symptom type presentation on periprocedural adverse event outcomes measure are summarized here.

Composite outcome: Death + stroke + MI

For both CAS and CEA treatment groups, stroke or TIA presentation predicted a higher risk of this composite outcome than ASX presentation.

Composite outcome: Death + stroke

For both CAS and CEA treatment groups, stroke or TIA presentation predicted a higher risk than ASX presentation.

Individual components of the composite outcomes

Death—In the CAS treatment group only, stroke presentation predicted a higher risk than TIA or ASX presentation.

Stroke—For both CAS and CEA treatment groups, stroke or TIA presentation predicted a higher risk than ASX presentation, as was reflected in the composite outcomes.

MI—No effect of presenting symptom type was noted on this outcome.

DISCUSSION

These data challenge practitioners to reconsider whether the binary classification of carotid lesions as either “asymptomatic” or “symptomatic” oversimplifies a more complex spectrum of disease. Our analyses demonstrate that specific presenting symptom types are powerful predictors of 30-day outcomes for CEA and CAS. In particular, the broad umbrella of symptomatic carotid disease encompasses several presenting symptoms with widely divergent perioperative risk profiles. Familiarity with these additional prognostic factors may allow clinicians to better counsel patients about treatment options and expected outcomes.

Are these expected outcomes broadly applicable to the multiple specialties that engage in performance of CEA and CAS? In their recent analysis of CREST, Timaran et al[15] demonstrated that vascular surgeon outcomes were statistically similar to those generated by other participating specialties. Thus, although vascular surgeons represent the majority of clinicians entering patient data into the SVS-VR, we expect that the influence of presenting symptom type on periprocedural outcomes would be a durable finding, regardless of the physician operator.

There are weaknesses of this study that deserve mention. The cohort of patients presenting with TMB (n = 508) is less well powered than in the other study groups, relatively limiting the strength of bivariate comparisons in those instances. The SVS-VR data are self-reported, with inherent potential for bias. In addition, the CEA and CAS patient groups are unmatched, and thus direct comparisons between such cohorts must be conducted with caution, even after concerted efforts at risk adjustment. For that reason, we have primarily sought to identify the prognostic significance of symptom type within the separate CAS and CEA treatment groups and limited comparisons between the therapeutic modalities. Longer term outcomes data would be desirable, but beyond the 30-day perioperative period, the SVS-VR data collection for carotid subjects becomes attenuated.

With regard to risk adjustment techniques, we strove to maximally risk adjust these populations before engaging in bivariate comparisons (Tables IV and V). The rationale for not using a cerebral protection device (CPD) is often not found within the SVS-VR. Thus, the reviewer cannot reliably determine whether failure to use a CPD was secondary to the elective choice of the interventionalist or due to anatomic constraints that rendered CPD use impossible. Of the 2882 CAS procedures examined, 71 (2.5%) did not use a CPD. The refusal or inability to use a CPD was associated with higher risk of stroke (11.3% vs 4.6 % with CPD use; $P = .009$). As we could not be certain whether CPD nonuse was elective or mandated by anatomy, we chose to risk adjust for CPD use in these analyses; that decision may have introduced bias favoring the outcomes of CAS. In light of the higher adverse event rates seen when CPDs were not used for CAS, CEA should be preferentially employed when this constraint is anticipated.

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References

1. Acheson J, Hutchinson EC. Observations on the natural history of transient cerebral ischaemia. Lancet. 1964; 2:871–4. [PubMed: 14197180]
2. Goldner J, Wisnant JP, Taylor WF. Long-term prognosis of transient cerebral ischemic attacks. Stroke. 1971; 2:160–7. [PubMed: 5151759]
3. Poole CJ, Ross Russell RW. Mortality and stroke after amaurosis fugax. J Neurol Neurosurg Psychiatry. 1985; 48:902–5. [PubMed: 4045484]
4. North American Symptomatic Carotid Endarterectomy Trial Collaborators. Beneficial effect of carotid endarterectomy in symptomatic patients with high-grade carotid stenosis. N Engl J Med. 1991; 325:445–53. [PubMed: 1852179]
5. Barnett HJ, Taylor DW, Eliasziw M, Fox AJ, Ferguson GG, Haynes RB, et al. Benefit of carotid endarterectomy in patients with symptomatic moderate or severe stenosis. North American Symptomatic Carotid Endarterectomy Trial Collaborators. N Engl J Med. 1998; 339:415–25. [PubMed: 9691113]
6. Streifler JY, Eliasziw M, Benavente OR, Harbison JW, Hachinski VC, Barnett HJ, et al. The risk of stroke in patients with first-ever retinal vs hemispheric transient ischemic attacks and high-grade carotid stenosis. North American Symptomatic Carotid Endarterectomy Trial. Arch Neurol. 1995; 52:246–9. [PubMed: 7872876]
7. Ferguson GG, Eliasziw M, Barr HW, Clagett GP, Barnes RW, Wallace MC, et al. The North American Symptomatic Carotid Endarterectomy Trial: surgical results in 1415 patients. Stroke. 1999; 30:751–8.
8. Bernstein EF, Dilley RB. Late results after carotid endarterectomy for amaurosis fugax. J Vasc Surg. 1987; 6:333–40. [PubMed: 3656582]
9. Executive Committee for the Asymptomatic Carotid Atherosclerosis Study. Endarterectomy for asymptomatic carotid artery stenosis. JAMA. 1995; 273:1421–8. [PubMed: 7723155]
10. Theron JG, Payelle GG, Coskun O, Huet HF, Guimaraens L. Carotid artery stenosis: treatment with protected balloon angioplasty and stent placement. Radiology. 1996; 201:627–36. [PubMed: 8939208]
11. Wholey MH, Wholey M, Bergeron P, Diethrich EB, Henry M, Laborde JC, et al. Current global status of carotid artery stent placement. Cathet Cardiovasc Diagn. 1998; 44:1–6. [PubMed: 9600512]
12. Yadav JS, Wholey MH, Kuntz RE, Fayad P, Katzen BT, Mishkel GJ, et al. Protected carotid-artery stenting versus endarterectomy in high-risk patients. N Engl J Med. 2004; 351:1493–501. [PubMed: 15470212]
13. Brott TG, Hobson RW 2nd, Howard G, Roubin GS, Clark WM, Brooks W, et al. Stenting versus endarterectomy for treatment of carotid-artery stenosis. N Engl J Med. 2010; 363:11–23. [PubMed: 20505173]
14. Sidawy AN, Zwolak RM, White RA, Siami FS, Schermerhorn ML, Sicard GA, et al. Risk-adjusted 30-day outcomes of carotid stenting and endarterectomy: results from the SVS Vascular Registry. J Vasc Surg. 2009; 49:71–9. [PubMed: 19028045]
15. Timaran CH, Mantese VA, Malas M, Brown OW, Lal BK, Moore WS, et al. Differential outcomes of carotid stenting and endarterectomy performed exclusively by vascular surgeons in the Carotid Revascularization Endarterectomy versus Stenting Trial (CREST). J Vasc Surg. 2013; 57:303–8. [PubMed: 23265585]

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Table I

Demographics and medical history

	Mutually exclusive symptom in last 12 months				
	Stroke (n = 947)	**TIA (n = 1449)**	**TMB (n = 508)**	**ASX (n = 5736)**	***P* value[a]**
Age, years (range)	69.7 (29–94)	71.6 (18–98)	69.7 (47–94)	71.2 (39–95)	<.0001
Gender, male (%)	61.1% (579/947)	59.8% (866/1449)	68.3% (347/508)	58.2% (3336/5736)	<.0001
Race, white	87.9% (832/947)	92.8% (1344/1449)	92.7% (471/508)	93.7% (5374/5736)	<.0001
Ethnicity, Hispanic	4.6% (44/947)	3.1% (45/1449)	2.8% (14/508)	3.2% (185/5736)	.1100
Coronary artery disease	45.3% (429/947)	49.6% (718/1449)	47.8% (243/508)	54.4% (3121/5736)	<.0001
MI	16.7% (158/947)	16.7% (242/1449)	16.9% (86/508)	19.2% (1104/5736)	.0437
Valvular heart disease	6.1% (58/947)	7.5% (109/1449)	6.5% (33/508)	7.6% (438/5736)	.3401
Cardiac arrhythmia	12.2% (116/947)	13.0% (188/1449)	12.8% (65/508)	14.0% (805/5736)	.3684
Congestive heart failure	10.7% (101/947)	10.0% (145/1449)	9.6% (49/508)	10.0% (574/5736)	.9184
Hypertension	84.6% (801/947)	83.8% (1214/1449)	76.4% (388/508)	84.7% (4861/5736)	<.0001
Diabetes	36.3% (344/947)	32.2% (467/1449)	28.0% (142/508)	32.7% (1877/5736)	.0118
Chronic obstructive pulmonary disease	18.0% (170/947)	19.3% (280/1449)	22.6% (115/508)	17.7% (1013/5736)	.0285
Chronic renal failure	4.0% (38/947)	3.5% (50/1449)	2.0% (10/508)	3.3% (192/5736)	.2294
Peripheral vascular disease	33.5% (317/947)	37.6% (545/1449)	36.0% (183/508)	43.9% (2520/5736)	<.0001
Current or past smoker	59.6% (564/947)	58.5% (847/1449)	66.5% (338/508)	60.9% (3494/5736)	.0120
Cancer	15.2% (144/947)	16.9% (245/1449)	19.1% (97/508)	14.2% (816/5736)	.0037
Coagulopathy	1.5% (14/947)	1.4% (20/1449)	0.6% (3/508)	1.3% (72/5736)	.5013
ASA grade					
≤3	88.1% (834/947)	91.5% (1326/1449)	92.9% (472/508)	92.1% (5282/5736)	.0004
>3	11.9% (113/947)	8.5% (123/1449)	7.1% (36/508)	7.9% (454/5736)	
New York Heart Association class					
≤2	93.7% (887/947)	92.1% (1335/1449)	93.3% (474/508)	93.7% (5372/5736)	.2147
>2	6.3% (60/947)	7.9% (114/1449)	6.7% (34/508)	6.3% (364/5736)	
Aspirin	79.3% (751/947)	84.9% (1230/1449)	82.9% (421/508)	84.9% (4872/5736)	.0001
Clopidogrel	46.5% (440/947)	50.0% (725/1449)	51.0% (259/508)	39.0% (2235/5736)	<.0001
Aspirin or clopidogrel	88.4% (837/947)	92.0% (1333/1449)	92.1% (468/508)	90.3% (5179/5736)	.0146
Age ≥80 years	20.3% (192/947)	23.2% (336/1449)	18.3% (93/508)	19.5% (1117/5736)	.0115

	Mutually exclusive symptom in last 12 months				
	Stroke (n = 947)	**TIA (n = 1449)**	**TMB (n = 508)**	**ASX (n = 5736)**	***P* value[a]**
Embolic protection (CAS only)	95.8% (322/336)	97.0% (554/571)	97.9% (184/188)	98.0% (1751/1787)	.0992

ASA, American Society of Anesthesiologists; *ASX*, asymptomatic; *CAS*, carotid artery stenting; *MI*, myocardial infarction; *TIA*, transient ischemic attack; *TMB*, transient monocular blindness.

[a] *P* value for age was found by analysis of variance. All others found by χ^2 tests.

Table II

Distribution by exclusive presenting symptom type and etiology

Etiology	Stroke, No. (%)	TIA, No. (%)	TMB, No. (%)	ASX, No. (%)	Total, No. (%)
CEA patients					
Atherosclerosis	604	862	313	3904	5683 (98.7)
Radiation	0	1	2	3	6 (0.1)
Restenosis	7	15	5	42	69 (1.2)
Total	611 (10.6)	878 (15.3)	320 (5.5)	3949 (68.6)	5758 (100)
CAS patients					
Atherosclerosis	293	413	140	1202	2048 (71.1)
Radiation	10	24	16	91	141 (5.9)
Restenosis	33	134	32	494	693 (24.0)
Total	336 (11.7)	571 (19.8)	188 (6.5)	1787 (62.0)	2882 (100)

ASX, Asymptomatic; *CAS*, carotid artery stenting; *CEA*, carotid endarterectomy; *TIA*, transient ischemic attack; *TMB*, transient monocular blindness.

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Table III

Unadjusted event rates by procedure and presenting symptom type

	CAS patients				
	Symptom in last 12 months (mutually exclusive)				
Thirty-day adverse event	**Stroke ipsilateral (n = 336)**	**TIA ipsilateral (n = 571)**	**TMB ipsilateral (n = 188)**	**ASX (n = 1787)**	***P* value[a]**
Death	6.3% (21/336)	1.1% (6/571)	0.5% (1/188)	1.3% (24/1787)	<.0001
Stroke	8.6% (29/336)	7.9% (45/571)	3.2% (6/188)	3.2% (57/1787)	<.0001
MI	1.2% (4/336)	1.2% (7/571)	1.6% (3/188)	1.1% (20/1787)	.8652
Death + stroke + MI	11.6% (39/336)	9.6% (55/571)	4.8% (9/188)	4.9% (88/1787)	<.0001
Death + stroke	11.0% (37/336)	8.4% (48/571)	3.2% (6/188)	4.3% (77/1787)	<.0001
	CEA patients				
	Symptom in last 12 months (mutually exclusive)				
Thirty-day adverse event	**Stroke ipsilateral (n = 611)**	**TIA ipsilateral (n = 878)**	**TMB ipsilateral (n = 320)**	**ASX (n = 3949)**	***P* value[a]**
Death	1.8% (11/611)	0.8% (7/878)	0.0% (0/320)	0.8% (30/3949)	.0277
Stroke	4.6% (28/611)	3.3% (29/878)	1.6% (5/320)	1.6% (64/3949)	<.0001
MI	0.8% (5/611)	1.6% (14/878)	0.9% (3/320)	1.2% (49/3949)	.6213
Death + stroke + MI	6.7% (41/611)	5.0% (44/878)	2.5% (8/320)	3.1% (124/3949)	<.0001
Death + stroke	6.2% (38/611)	4.0% (35/878)	1.6% (5/320)	2.2% (87/3949)	<.0001

ASX, Asymptomatic; *CAS*, carotid artery stenting; *CEA*, carotid endarterectomy; *MI*, myocardial infarction; *TIA*, transient ischemic attack; *TMB*, transient monocular blindness.

Events were defined as any event occurring intraoperatively, before discharge, or between discharge and 30 days. The event rates in the table are per patient.

[a] *P* values were based on Fisher exact test.

Table IV

Risk-adjusted bivariate comparison of outcomes based on presenting symptom types within the carotid artery stenting (*CAS*) treatment group

	CAS: Multivariable (adjusted) logistic models					
	Ipsilateral symptom					
Thirty-day outcome	**Comparison group**	**Reference group**	**OR**	**95% CI**	***P* value**	**Adjusted covariates**
Death/stroke/MI outcome	Stroke	vs TIA	1.08	0.69–1.71	.7274	Controls for age, white race, diabetes, ASA grade, clopidogrel, and CPD use
		vs TMB	2.03	0.95–4.37	.0689	
		vs ASX	2.30	1.52–3.47	<.0001[a]	
	TIA	vs TMB	1.88	0.90–3.92	.0941	
		vs ASX	2.12	1.48–3.04	<.0001[a]	
	TMB	vs ASX	1.13	0.55–2.30	.7386	
Death/stroke outcome	Stroke	vs TIA	1.16	0.72–1.86	.5481	Controls for age, white race, diabetes, ASA grade, aspirin, clopidogrel, and CPD use
		vs TMB	2.88	1.17–7.07	.0209	
		vs ASX	2.43	1.58–3.73	<.0001[a]	
	TIA	vs TMB	2.49	1.04–5.99	.0412	
		vs ASX	2.10	1.43–3.08	.0002[a]	
	TMB	vs ASX	0.84	0.36–1.98	.6933	
Death outcome	Stroke	vs TIA	5.21	2.04–13.33	.0006[a]	Controls for ASA grade, aspirin, and CPD use
		vs TMB	10.03	1.32–76.25	.0259	
		vs ASX	3.87	2.08–7.23	<.0001[a]	
	TIA	vs TMB	1.92	0.23–16.27	.5476	
		vs ASX	0.74	0.30–1.85	.5238	
	TMB	ASX	0.39	0.05–2.90	.3549	
Stroke outcome	Stroke	vs TIA	0.97	0.58–1.61	.9050	Controls for age, white race, diabetes, ASA grade, clopidogrel, and CPD use
		vs TMB	2.20	0.88–5.47	.0905	
		vs ASX	2.59	1.60–4.18	<.0001[a]	
	TIA	vs TMB	2.27	0.94–5.45	.0674	
		vs ASX	2.67	1.77–4.03	<.0001[a]	
	TMB	vs ASX	1.18	0.50–2.79	.7102	
MI outcome	Stroke	vs TIA	1.04	0.30–3.58	.9514	Controls for CAD

	CAS: Multivariable (adjusted) logistic models					
	Ipsilateral symptom					
Thirty-day outcome	**Comparison group**	**Reference group**	**OR**	**95% CI**	***P* value**	**Adjusted covariates**
		vs TMB	0.75	0.17–3.42	.7150	
		vs ASX	1.12	0.38–3.32	.8324	
	TIA	vs TMB	0.73	0.19–2.84	.6461	
		vs ASX	1.08	0.45–2.57	.8595	
	TMB	vs ASX	1.49	0.44–5.07	.5241	

ASA, American Society of Anesthesiologists; *ASX*, asymptomatic; *CAD*, coronary artery disease; *CI*, confidence interval; *CPD*, cerebral protection device; *MI*, myocardial infarction; *OR*, odds ratio; *TIA*, transient ischemic attack; *TMB*, transient monocular blindness.

[a] $P < .0083$ considered significant after Bonferroni correction for multiple comparisons.

Table V

Risk-adjusted bivariate comparison of outcomes based on presenting symptom types within the carotid endarterectomy (*CEA*) treatment group

	CEA: Multivariable (adjusted) logistic models					
	Ipsilateral symptom					
Thirty-day outcome	**Comparison group**	**Reference group**	**OR**	**95% CI**	***P* value**	**Adjusted Covariates**
Death/stroke/MI outcome	Stroke	vs TIA	1.30	0.83–2.03	.2466	Controls for age, white race, CAD, diabetes, ASA grade, and aspirin use
		vs TMB	2.56	1.18–5.57	.0174	
		vs ASX	2.12	1.46–3.08	<.0001[a]	
	TIA	vs TMB	1.97	0.91–4.25	.0844	
		vs ASX	1.63	1.14–2.33	.0073[a]	
	TMB	vs ASX	0.83	0.40–1.72	.6120	
Death/stroke outcome	Stroke	vs TIA	1.50	0.93–2.41	.0935	Controls for ASA grade and aspirin use
		vs TMB	3.85	1.50–9.91	.0052[a]	
		vs ASX	2.73	1.84–4.05	<.0001[a]	
	TIA	vs TMB	2.56	0.99–6.62	.0517	
		vs ASX	1.82	1.22–2.72	.0035[a]	
	TMB	vs ASX	0.71	0.29–1.76	.4598	
Death outcome	Stroke	vs TIA	2.07	0.79–5.41	.1361	Controls for ASA grade and aspirin use
		vs ASX	2.10	1.04–4.23	.0388	
	TIA	vs ASX	1.01	0.44–2.32	.9796	
Stroke outcome	Stroke	vs TIA	1.36	0.80–2.32	.2546	Controls for diabetes, TMB, and ASA grade
		vs TMB	4.58	1.36–15.42	.0140	
		vs ASX	2.79	1.77–4.40	<.0001[a]	
	TIA	vs TMB	3.36	1.01–11.17	.0478	
		vs ASX	2.05	1.31–3.20	.0016[a]	
	TMB	vs ASX	0.61	0.19–1.98	.4113	
MI outcome	Stroke	vs TIA	0.51	0.18–1.42	.1972	Controls for age, white race, CAD, and diabetes
		vs TMB	0.84	0.20–3.55	.8098	
		vs ASX	0.67	0.27–1.71	.4041	
	TIA	vs TMB	1.65	0.47–5.83	.4346	

	CEA: Multivariable (adjusted) logistic models					
	Ipsilateral symptom					
Thirty-day outcome	**Comparison group**	**Reference group**	**OR**	**95% CI**	***P* value**	**Adjusted Covariates**
		vs ASX	1.33	0.73–2.43	.3584	
	TMB	vs ASX	0.80	0.25–2.61	.7156	

ASA, American Society of Anesthesiologists; *ASX*, asymptomatic; *CAD*, coronary artery disease; *CI*, confidence interval; *MI*, myocardial infarction; *OR*, odds ratio; *TIA*, transient ischemic attack; *TMB*, transient monocular blindness.

[a] $P < .0083$ considered significant after Bonferroni correction for multiple comparisons.