Cost-effectiveness of carotid artery stenting vs endarterectomy: A simulation

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Objective: Clinical trials conducted before the introduction of modern medical management to prevent stroke demonstrated that carotid endarterectomy (CEA) and carotid artery stenting (CAS) prevent stroke following transient ischemic attack (TIA). We compared the cost-effectiveness of CEA, CAS, and modern medical management in two secular settings of medical management in individuals with incident TIA and type 2 diabetes. *Methods:* Using simulation modeling, our base-case analyses were performed from the healthcare sector perspective over a 20-year time horizon with an annual 3% discount rate applied to both costs and quality-adjusted life years (QALYs). Outcomes depended on age, sex, biomarkers associated with cardiovascular risk, and treatment effects based on a validated model of type 2 diabetes. Our simulation population was drawn from the National Health and Nutrition Examination Survey (NHANES) 2014 cohort. Costs for modern medical management were based on average wholesale prices, and revascularization costs were derived from published literature. One-way and probabilistic sensitivity analyses were conducted. *Results:* Compared to all other strategies, historical medical management plus CEA was either cost-saving or cost-effective at a threshold of $100,000 per QALY gained. Modern medical management was cost-effective compared to historical medical management without revascularization at a $100,000 acceptability threshold. However, both revascularization approaches (plus medical management) were cost-saving compared to modern medical management alone. *Conclusion:* Among individuals requiring carotid revascularization, carotid endarterectomy is the cost-effective strategy to treat individuals with type 2 diabetes following a TIA. For individuals for whom revascularization is contraindicated, modern medical therapy is cost-effective.

Keywords: stroke—type 2 diabetes mellitus—transient ischemic attack

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Abbreviation: CVD, Cardiovascular disease; TIA, Transient ischemic attack; T2DM, Type 2 diabetes; CEA, Carotid endarterectomy; CAS, Carotid artery stenting; ACAS, Asymptomatic Carotid Atherosclerosis; NASCET, North American Symptomatic Carotid Endarterectomy Trial; ECST, European Carotid Surgery Trial; CREST, Carotid Revascularization Endarterectomy versus Stenting Trial; CREST-2, Carotid Revascularization Endarterectomy versus Stenting Trial 2; MMD, Michigan Model for Diabetes; CHD, Coronary heart disease; QALY, Quality-adjusted life year; ICERs, Incremental cost-effectiveness ratios

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INTRODUCTION

Cardiovascular disease (CVD) is an important cause of morbidity, mortality, and health care expenditures in US adults with type 2 diabetes (T2DM). CVD in Medicare beneficiaries with T2DM accounts for 50% of total Medicare expenditures.[1] The risk of stroke in people with T2DM is twice that of individuals without diabetes, and stroke is the leading cause of serious long-term adult disability in the US.[2] Stroke prevention among individuals with T2DM may reduce the subsequent morbidity, mortality, and cost of CVD. Because the risk of stroke within 6 months of transient ischemic attack (TIA) has been estimated to be as high as 15%,[3] carotid revascularization following TIA may be a particularly effective and cost-effective strategy to prevent stroke and reduce disability.

Over the past 2 decades, studies have defined preventive strategies to improve long-term CVD outcomes. Carotid endarterectomy (CEA) and carotid artery stenting (CAS) are well established treatments to prevent stroke following TIA, even in individuals over 70 years of age.[4,5] Even though the cost of CEA itself is not trivial,[6–8] CEA following TIA has been shown to reduce the risk of incident ischemic stroke from 25% to less than 6%,[9] thereby reducing morbidity, disability, mortality, and cost.[4,5]

The definitive studies demonstrating the effectiveness of CEA (Asymptomatic Carotid Atherosclerosis Study (ACAS),[10] North American Symptomatic Carotid Endarterectomy Trial (NASCET),[11] and European Carotid Surgery Trial (ECST)[12]) were conducted in the 1980s and 1990s, before the widespread use of newer anti-platelet therapies and high-intensity statins (atorvastatin, rosuvastatin) and before the introduction of newer, more aggressive guidelines for blood pressure control. CAS, in turn, has been shown to be non-inferior to CEA.[13]

However, medical treatment has improved in the decades since these trials, and neither CEA nor CAS have been compared to modern medical treatment alone. Thus, some researchers and policy makers question the utility of CEA and CAS relative to modern medical management alone.[4,5,8] The Carotid Revascularization Endarterectomy versus Stenting Trial 2 (CREST-2), a large and well-designed clinical trial, is testing the efficacy of CEA and CAS vs modern medical management.[14] However, the CREST-2 trial is not assessing the long-term cost-effectiveness of these treatments, and by the time long-term outcomes of CREST-2 are available, standards of care may have changed again. Fortunately, fully developed and validated simulation models of CVD that are based on the best available observational and clinical trial data and account for the trajectory of complications and comorbidities of both diabetes and CVD can be used to inform practice guidelines.

Our aim was to simulate the cost-effectiveness of three competing treatment paradigms: CEA, CAS, and medical management alone in each of two settings: historical medical management and modern medical management. This led to a total of 6 treatment scenarios for cost-effectiveness analysis. Our population of interest was people with incident TIA and T2DM who were candidates for carotid revascularization, defined as either CEA or CAS.

METHODS

Our cost-effectiveness analysis was conducted using simulation modeling with 1,000 replications. Our base case scenario involved 20 years of follow-up, and we made modifications to the base model for each of 5 additional scenarios.

Simulation Specifications for Base Case Model

The Michigan Model for Diabetes (MMD), an externally-validated model of diabetes progression, was the basis for our simulation. It describes the trajectory of patients with T2DM as they age and develop risk factors, complications, and comorbidities of diabetes. These include hyperglycemia, hypertension, dyslipidemia, retinopathy, nephropathy, neuropathy, cerebrovascular disease, and coronary heart disease (CHD).[15] The model includes event states including TIA, ischemic stroke, and myocardial infarction. Individuals experiencing acute events then progress to annual states including history of TIA, history of ischemic stroke with minor disability, major disability, and death. Time-varying biomarkers (e.g., BMI, HbA1c, blood pressure, lipids) are updated annually as a function of time and treatment.[16,17] These time-varying covariates, in turn, modify the risk for progression to complications and CVD. The biomarker model also triggers a model of treatment and adherence, as outlined in our CHD model, which includes prescription of and adherence to treatments (e.g., antiplatelet agents, glucose-lowering medications, blood pressure-lowering medications, and lipid-lowering medications).[15,17] These treatments directly and indirectly influence individual risk factors and disease trajectories over time. Medical management is modeled in the MMD by changing risk factor levels (i.e., fasting glucose, blood pressure, and lipids) and through direct effects of pharmacologic therapies (such as antiplatelet agents) on outcomes.[15] Unlike simulation models that are constrained to a single longitudinal data set, the MMD integrates estimates from multiple data sources to create a single self-consistent system of disease progression equations. Finally, we used cutting-edge calibration techniques[17] to account for secular trends[18] and integrate the best epidemiological studies with the results of modern clinical trials.

Treatment Scenarios

Our treatment scenarios considered 3 competing treatment paradigms: medical management alone, medical management plus CEA, and medical management plus CAS in each of two settings: historical medical management (insulin, metformin, sulfonylureas, aspirin, atenolol, and moderate-intensity statin therapy) versus modern medical management (semaglutide, clopidogrel, losartan, and high-intensity statin therapy). Thus, we have a total of 6 scenarios and 15 possible pairwise comparisons.

Historical medical management used the default diabetes treatments described above, based on clinical practice guidelines. For modern medical management, we changed glycemic management from generic sulfonylureas to semaglutide[19](maintaining treatment with metformin and insulin), anti-platelet therapy from aspirin to clopidogrel plus aspirin,[20] blood pressure management from atenolol (representative of clinical guidelines in the 1980's when ACAS, NASCET, and ECST were initiated) to losartan,[21] and lipid management from atorvastatin 10 mg (moderate-intensity therapy) to atorvastatin 80 mg (high-intensity therapy).[22] The stroke risk reduction due to these therapies relative to the historical therapies were based on the results of modern clinical trials and standards of care for patients with type 2 diabetes[19–23] (Table 1). These therapies may have either a direct effect on stroke risk, or an indirect effect through risk-factor management. Combinations of multiple treatments were considered to be additive. Likewise, differences in quality-of-life following CEA and CAS have been shown to dissipate within 12 months.[24] Thus, we did not model a change in quality-of-life associated with these carotid revascularization procedures.

To model the incidence of stroke following treatment with CEA and CAS, we used results from the CREST[25] as a function of age[26] as displayed in Table 1. This included both short and long term risk of stroke. A meta-analysis of CAS vs CEA demonstrated no difference in myocardial infarction between the two treatments, so we did not model an additional cardiac effect.[27] The incidence of stroke following treatment was based on a the NASCET results for symptomatic patients with high-grade carotid stenosis.[28]

Simulation Population

To acquire baseline data for correlated risk factors, we sampled 400 individuals with diabetes from the 2014 NHANES cohort as our simulation population. Because we were interested in risk among people with type 2 diabetes, and because NHANES did not have an indicator for TIA or eligibility for CAS or CEA, we sampled the NHANES cohort with diabetes to replicate the demographic characteristics of CREST participants. We weighted observations by the inverse distance from CREST's mean of age, sex, hypertension status, smoking status, systolic blood pressure, and diastolic blood pressure. To simulate a more racially diverse sample than enrolled in CREST, we did not sample based on race. These baseline data were used for all simulated scenarios

Table 1. *Transition parameters for treatment strategies*

Variable	Value	Reference
Stroke risk reduction due to modern medicine		
Clopidogrel + aspirin	0.70	20
Losartan	0.75	21
Atorvastatin	0.52	22
Semaglutide	0.61	19
Probability of progression from TIA to stroke		
No surgical treatment	0.20	28
CAS, age <= 65	0.03	26
CAS, age 65-74	0.06	26
CAS, age >= 75	0.11	26
CEA, age <= 65	0.05	26
CEA, age 65-74	0.05	26
CEA, age >= 75	0.07	26
Probability of progression from history of TIA to stroke		
No surgical treatment	0.156	28
CAS, age <= 65	0.003	26
CAS, age 65-74	0.002	26
CAS, age >= 75	0.006	26
CEA, age <= 65	0.003	26
CEA, age 65-74	0.007	26
CEA, age >= 75	0.001	26

Abbreviations: CAS, carotid artery stenting; CEA, carotid endarterectomy; TIA, transient ischemic attack.

Table 2. *Intervention costs of historical, modern medical, and surgical management*

Intervention	Drug	Dosage	Form, strength	AWP unit price	Yearly cost (2014 US$)
Pharmacological Management				reference: 15	
Antiplatelet agent	Aspirin	81 mg/d, PO, once daily	Tab, 81 mg	0.01	4
	Clopidogrel	75 mg/d, PO, once daily	Tab, 75 mg	0.433	158
Antihypertensive agent					
Half of max. daily dose	Losartan	50 mg/d, PO, once daily	Tab, 50 mg	0.15	55
Max. daily dose	Losartan	100 mg/d, PO, once daily	Tab, 100 mg	0.17	62
Beta Blocker					
Half of max. daily dose	Atenolol	50 mg/d, PO, once daily	Tab, 50 mg	0.25	91
Max. daily dose	Atenolol	100 mg/d, PO, once daily	Tab, 100 mg	1.19	434
Max. daily dose	Metoprolol succinate	100 mg/d, PO, twice daily	Tab, 100 mg	1.58	1153
Statin					
Moderate-intensity therapy	Atorvastatin	10 mg/d, PO, once daily	Tab, 10 mg	0.06	22
High-intensity therapy	Atorvastatin	40 mg/d, PO, once daily	Tab, 40 mg	.20	71
Glucose-lowering agent					
	Metformin	1,000 mg/d, PO, twice daily	Tab, 1,000 mg	0.07	51
	Semaglutide	1 mg/wk, SC, once weekly	Prefilled pen, 2 mg/1.5 mL	430	11,180
Surgical Management					reference: 32
CAS					14,036
CEA					19,215

Abbreviations: d, day; PO, orally; wk, week; SC, subcutaneous; Tab, tablet; AWP, average wholesale price; CAS, carotid artery stenting; CEA, carotid endarterectomy.

to compare medical management among individuals with T2DM eligible for carotid revascularization procedures.

All subjects, on initiating the simulation, were assumed to have had an incident TIA at baseline which triggered treatment with medical management, CEA, or CAS. Other baseline demographics, risk factors, medical history, and medical management were determined from the NHANES data.

Simulation Costs

We used an Impact Inventory (Supplemental Table 1), as recommended by the Second Panel on Cost-Effectiveness in Health and Medicine,[29,30] and adopted a health care sector perspective. We applied an annual 3% discount rate to both costs and QALYs. The economic analyses were reported in compliance with the Consolidated Health Economic Evaluation Reporting Standards 2022 (CHEERS 2022).[31]

Costs for medical management were based on average wholesale prices in Red Book and are displayed in Table 2.[15,32] For the carotid revascularization procedures, costs were based on total in-hospital patient cost, including fixed costs (administrative, capital, and utilities) and variable costs (labor and supply) as noted in Table 2.

Comparing Competing Approaches

To identify the best treatments, we used a 2-stage approach. First, we ordered the 6 strategies by average total cost and eliminated competing treatments that were both more expensive and less effective than another treatment. Second, we used incremental cost-effectiveness ratios (ICERs) to measure the relative cost-effectiveness of the treatments that were not eliminated in the first step. The ICER represents the additional cost required to achieve one additional unit of health benefit (QALY) when comparing treatment strategies.[30] Costs are reported in 2018 dollars, and health benefits were monetized using a US$100,000 per QALY threshold.

Sensitivity Analysis

We performed sensitivity analyses assessing the length of follow-up by simulating results for 10 and 30 years as well as our base case of 20 years. Sensitivity analyses were also performed with respect to disease progression and costs. We limited our sensitivity analyses to treatment strategies which were not dominated by some other strategy. One-way sensitivity analyses for the probability of stroke and for costs were performed by increasing and decreasing the simulation parameters by one standard error based on the literature[6,33–36] as displayed in Table 3. Multiple estimates were available for the probability of incident stroke without carotid revascularization treatment and its cost . We used the range of reported costs divided by 4 to estimate the standard error[34–36]. In addition, we performed a probabilistic sensitivity analysis that varied the parameters related to the probability of stroke, QALYs, and costs simultaneously using the same

Table 3. *Standard deviations used for probabilistic sensitivity analysis*

Variable	Value	Reference
Progression of stroke with no surgical treatment	0.01	26
Progression of stroke following CAS and CEA periprocedural, age <=74	0.007	26
Progression of stroke following CAS periprocedural, age >= 75	0.014	26
Progression of stroke following CEA periprocedural, age >= 75	0.009	26
Progression of stroke following CAS and CEA post procedural, age <=64 and CEA, age <=74	0.015	26
Progression of stroke following CAS post procedural, age 65-74	0.019	26
Progression of stroke following CAS and CEA post procedural, age >= 75	0.022	26
Cost of CAS	$1,000	34-36
Cost of CEA	$750	34-36

Abbreviations: CAS, carotid artery stenting; CEA, carotid endarterectomy.

variances. Each sensitivity analysis was replicated 100 times to estimate the cost-effectiveness of each treatment strategy.

RESULTS

Supplemental Table 2 compares the demographic characteristics of our simulated population to those of the CREST cohort. Individuals in our simulation population were similar to the CREST population for measures of age, sex, smoking status, hypertension status, systolic blood pressure, and diastolic blood pressure. In the CREST study, 93% of participants were white. In contrast, due to our sampling design from NHANES, only 70% of individuals in our simulation population were white.

Table 4 summarizes the ICERs for all pairwise comparisons of the 6 treatment-scenarios over 20 years. Compared to all other strategies, historical medical management plus CEA was either cost-saving or cost-effective at a threshold of $100,000 per QALY gained. Modern medical therapy alone had the highest total cost per person due to the increased incidence of stroke and its associated cost.

Considering the clinical scenario where carotid revascularization procedures are contra-indicated, the ICER for modern medical management alone versus historical medical management alone was $32,037 per QALY

Table 4. *Incremental cost-effectiveness ratios for comparisons between 6 scenarios*

Base case: 20 years	Lower total cost Higher total cost				
					MM alone
				MM+CAS	Cost-saving
			MM+CEA	Cost-saving	Cost-saving
		HM alone	Not cost-effective	Not cost-effective	Not cost-effective
	HM+CAS	Cost-saving	$198,123	$224,653	Cost-saving
HM+CEA	Cost-saving	Cost-saving	$239,093	$267,043	Cost-saving
Sensitivity analysis: 10 years					
					MM alone
				MM+CAS	Cost-saving
			MM+CEA	Cost-saving	Cost-saving
		HM alone	Not cost-effective	Not cost-effective	Not cost-effective
	HM+CAS	Cost-saving	$288,525	$358,787	Cost-saving
HM+CEA	Cost-saving	Cost-saving	$408,438	$489,104	Cost-saving
Sensitivity analysis: 30 years					
					MM alone
				MM+CAS	$3,585
			MM+CEA	Cost-saving	$970
		HM alone	Not cost-effective	Not cost-effective	Not cost-effective
	HM+CAS	Cost-saving	$161,111	$179,749	Cost-saving
HM+CEA	Cost-saving	Cost-saving	$188,567	$207,361	Cost-saving

Abbreviations: HM, historical medical management; CAS, carotid artery stenting; CEA, carotid endarterectomy; MM, modern medical management.

Notes: 1) Strategies are reported by the order of total cost in the base case analysis. Incremental cost-effectiveness ratios are reported as the row-defining strategy compared with the column-defining strategy. 2) The white cells indicate comparisons within a setting. The light grey cells indicate comparisons between the two settings for a given treatment modality, while the dark grey cells indicate comparisons between different settings and treatment modalities.

Table 5. *Simulated costs and QALYs per person for 6 treatment scenarios*

		Historical Medical Management			Modern Medical Management		
		Alone	CEA	CAS	Alone	CEA	CAS
Total Cost	10 year	$205,792	$160,453	$165,606	$210,663	$187,027	$192,155
	20 year	$339,269	$300,498	$306,223	$365,893	$345,619	$350,898
	30 year	$396,446	$385,806	$392,416	$437,119	$439,354	$445,390
Treatment Cost	10 year	$47,909	$72,716	$78,070	$82,306	$105,834	$111,176
	20 year	$86,957	$138,558	$143,921	$144,352	$193,132	$198,693
	30 year	$105,741	$180,595	$185,891	$172,438	$243,710	$249,610
Complication Cost	10 year	$157,882	$87,737	$87,535	$128,357	$81,193	$80,979
	20 year	$252,312	$161,939	$162,302	$221,540	$152,487	$152,206
	30 year	$290,705	$205,212	$206,525	$264,681	$195,643	$195,780
QALY	10 year	3.72	4.64	4.63	4.12	4.71	4.71
	20 year	5.31	7.54	7.53	6.14	7.73	7.73
	30 year	5.87	8.91	8.91	6.89	9.20	9.20

Abbreviations: CAS, carotid artery stenting; CEA, carotid endarterectomy; QALY, quality-adjusted life year.

gained, which is cost-effective at an acceptability threshold of $100,000 per QALY gained. Considering clinical instances where individuals are already receiving modern medical management, adding CEA was cost-saving compared to either adding CAS or medical management alone. In particular, the QALYs associated with modern medical management plus CEA were nearly identical to modern medical management plus CAS. This near equality in QALYs was driven by the complication rate in the simulated outcomes. For 20-year outcomes, the simulated incidence of ischemic stroke was 0.52% and 0.31% respectively in modern medical management plus CEA and modern medical management plus CAS. However, the rates of myocardial infarction (0.75% and 0.74% per person-year, respectively) and coronary heart failure (1.8% and 1.8% per person-year, respectively) were

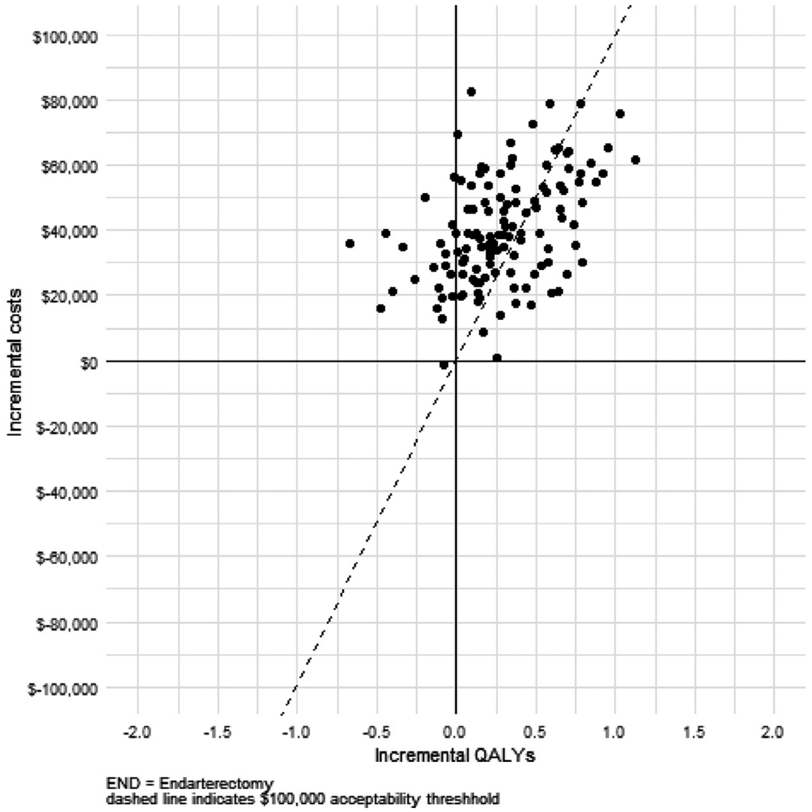

Figure 1. *caption: Probabilistic Sensitivity Analysis between Historical Medical Management plus CEA and Modern Medical management plus CEA.*

substantially higher than the rates of ischemic stroke and drove the QALYs for these two scenarios. Thus, the combination of lower cost of CEA and very similar QALYs resulted in ICERs of extremely large magnitude (Table 5).

In sensitivity analyses, we compared historical medical management plus CEA and modern medical management plus CEA, because these strategies were the only ones which were not strictly dominated by some other strategy. In the one-way sensitivity analyses, the ICERs ranged from $51,442 to $303,893 per QALY gained. Only in scenarios where the stroke incidence was at its lower limit, and where semaglutide had 4 generic competitors, did the ICER fall below a $100,000 per QALY gained threshold (ICERS of $51,442 and $82,932 respectively). In probabilistic sensitivity analysis, at thresholds of $50,000 and $100,000 per QALY gained, historical medical management plus CEA was considered cost-effective compared to modern medical management plus CEA in 6.3% and 32.0% of model iterations from a health care sector perspective, respectively. Figure 1 shows a plot of the outcomes for the sensitivity analysis.

DISCUSSION

We simulated the long-term health and economic outcomes of carotid revascularization procedures following incident TIA among people with type 2 diabetes and compared two types of medical management: historical medical management with aspirin, sulphonylurea, atenolol, and moderate-intensity statin therapy versus modern medical management with clopidogrel, semaglutide, losartan, and high-intensity statin therapy. We found that, in scenarios with both historical and medical management, CEA is either cost-saving or cost-effective at a $100,000 acceptability threshold per QALY gained, compared to other strategies. For a patient who has already undergone CEA, changing from historical to modern medical management is not cost-effective (ICER > 100,000 per QALY). However, modern medical management is cost-effective compared to historical medical management without carotid revascularization procedures at a $100,000 acceptability threshold. Therefore, our results suggest that CEA is the most important element of management for carotid revascularization candidates with T2DM following a TIA.

The cost-effectiveness of CEA in the historical setting was driven by a reduction in down-stream complications combined with the low cost of treatment. Not only did the total cost of care decrease with CEA, but the QALYs increased compared to other treatments within a historical context. This is consistent with the decreased risk of subsequent stroke observed with CEA in CREST.[13,26] Over the course of a 20-year simulation, a small reduction in stroke rates yields lower complication costs and greater health related quality-of-life.

The literature has reported mixed results when estimating the cost-effectiveness of CAS versus CEA. The SAPPHIRE trial found that CAS was cost-effective relative to CEA (ICER= $67,891 per QALY for CAS vs CEA).[34] However, the SAPPHIRE trial focused on populations with a very high risk of complications. Over 75% of their subjects had CHD.[34] In studies that recruited subjects with lower CVD risk, CAS typically was not cost-effective. For example, one 4-year simulation study based on the CREST population, in which 40% of subjects had histories of cardiovascular disease, reported an ICER of >$200,000 per QALY for CAS vs CEA.[36] Another study using CREST subjects reported an ICER of $65,500 per QALY.[14] Analyses based on early studies, comparable to our historical setting, found no difference between the two procedures.[35,37,38] Our results, which suggest that CAS is not cost-effective compared to CEA, are consistent with the CREST study[13,25] which found that CEA was cost-effective compared to CAS within CREST's historical setting.[14] We look forward to comparing our results for modern medical management to the CREST-2 results.

When we compared historical medical management versus modern medical management, the difference in ICERs was driven primarily by medication costs. Over the course of 20 simulated years, the medication costs under modern medical management were almost $60,000 greater than for historical medical management. These additional costs translated into a total cost difference of less than $5,500 for each of the treatment modalities due to a reduction in complications. Therefore, for individuals who are not carotid revascularization candidates, modern medical management is cost-effective. Moreover, the primary cost of modern medical management was semaglutide. Our sensitivity analysis suggested that if there were 4 generic options for semaglutide on the market, modern medical management plus CEA would be cost-effective relative to historical medical management plus CEA.

Our choice of modern medical management was based on guidelines for diabetes management, which may have a direct or indirect effect on stroke risk. For example, although there is some evidence that clopidogrel is only slightly superior to aspirin for stroke prevention, evidence from the CHANCE and POINT trials suggests that dual antiplatelet therapy with aspirin and clopidogrel for 21-30 days after high-risk TIA reduces stroke risk.[20,39] Our model accounts only for treatment effects over each year, not the short-term treatment effects of dual antiplatelet therapy with aspirin and clopidogrel, suggesting that our estimates of the cost-effectiveness of CEA plus modern medical therapy were conservative.

Limitations of our study include the assumptions inherent in any simulation model. We have managed this limitation by using an externally validated model and by performing sensitivity analyses. Although our results assume that prices do not change and new treatments do not come onto the market during the simulation period, our simulations provide an estimate of the long-term benefits of these competing treatments without additional intervention. As prices change and modern medical therapy improves over time, further comparisons can be considered. In addition, our sensitivity analyses suggested that our results are robust to variability in the input parameters. We found that adding Proprotein convertase subtilisin/kexin type 9 serine protease (PCSK9) inhibitors to the modern medical management of dyslipidemia was not cost-effective at a $100,000 acceptability threshold compared to modern medical management without PCSK9 inhibitors due to their high cost (data not shown). Another limitation is that we simulated a racially diverse population using treatment effects that were derived from a study performed in a largely white population. Thus, our results represent the economic outcomes assuming that racial disparities are not present. When data become available to estimate the effect of racial disparities, we can update our model to reflect those disparities and to estimate the benefit of eliminating racial disparities in the treatment of TIA.

In conclusion, we found that the effect of CEA dominates the effect of modern medical therapy in people with diabetes and incident TIA. However, if revascularization is contraindicated, modern medical management is cost-effective compared to historical medical management alone.

Potential Conflicts of Interests

DM: None

SK: None

WY: None

DL: None.

WH: Dr. Herman is a member of a Data Safety Monitoring Board for Merck Sharp & Dohme

Author role

DI: acquisition and analysis of data, drafting a significant portion of manuscript and tables

SK: drafting a significant portion of manuscript and tables

WY: critical review of manuscript

DL: significant clinical review

WH: conception and design of the study, significant clinical review

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Supplementary materials

Supplementary material associated with this article can be found in the online version at doi:10.1016/j.jstrokecerebrovasdis.2022.106908.

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