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A comparison of results with eversion versus conventional carotid endarterectomy from the Vascular Quality Initiative and the Mid-America Vascular Study Group

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Abstract

Objective—Carotid endarterectomy (CEA) is usually performed with eversion (ECEA) or conventional (CCEA) technique. Previous studies report conflicting results with respect to outcomes for ECEA and CCEA. We compared patient characteristics and outcomes for ECEA and CCEA.

Methods—Deidentified data for CEA patients were obtained from the Society for Vascular Surgery Vascular Quality Initiative (SVS VQI) database for years 2003 to 2013. Second (contralateral) CEA, reoperative CEA, CEA after previous carotid stenting, or CEA concurrent with cardiac surgery were excluded, leaving 2365 ECEA and 17,155 CCEA for comparison. Univariate analysis compared patients, procedures, and outcomes. Survival analysis was also performed for mortality. Multivariate analysis was used selectively to examine the possible independent predictive value of variables on outcomes.

Results—Groups were similar with respect to sex, demographics, comorbidities, and preoperative neurologic symptoms, except that ECEA patients tended to be older (71.3 vs 69.8

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years; *P* < .001). CCEA was more often performed with general anesthesia (92% vs 80%; *P* < .001) and with a shunt (59% vs 24%; *P* < .001). Immediate perioperative ipsilateral neurologic events (ECEA, 1.3% vs CCEA, 1.2%; *P* = .86) and any ipsilateral stroke (ECEA, 0.8% vs CCEA, 0.9%; *P* = .84) were uncommon in both groups. ECEA tended to take less time (median 99 vs 114 minutes; *P* < .001). However, ECEA more often required a return to the operating room for bleeding (1.4% vs 0.8%; *P* = .002), a difference that logistic regression analysis showed was only partly explained by differential use of protamine. Life-table estimated 1-year freedom from any cortical neurologic event was similar (96.7% vs 96.7%). Estimated survival was similar comparing ECEA with CCEA at 1 year (96.7% vs 95.9%); however, estimated survival tended to decline more rapidly in ECEA patients after ~2 years. Cox proportional hazards modeling confirmed that independent predictors of mortality included age, coronary artery disease, chronic obstructive pulmonary disease, and smoking, but also demonstrated that CEA type was not an independent predictor of mortality. The 1-year freedom from recurrent stenosis >50% was lower for ECEA (88.8% vs 94.3%, *P* < .001). However, ECEA and CCEA both had a very high rate of freedom from reoperation at 1 year (99.5% vs 99.6%; *P* = .67).

Conclusions—ECEA and CCEA appear to provide similar freedom from neurologic morbidity, death, and reintervention. ECEA was associated with significantly shorter procedure times. Furthermore, ECEA obviates the expenses, including increased operative time, associated with use of a patch in CCEA, and a shunt, more often used in CCEA in this database. These potential benefits may be reduced by a slightly greater requirement for early return to the operating room for bleeding.

Carotid endarterectomy (CEA) is among the most commonly performed noncoronary arterial interventions in North America and has been shown to reduce the risk of stroke and other neurologic complications in selected patients with high-grade atherosclerotic disease of the carotid bifurcation.[1,2] The procedure-related risk of stroke is low in well-selected patients. However, the effect of stroke in patients undergoing CEA is substantial in terms of patient independence, quality of life, and resource utilization.[3,4] Although the rate of any major adverse event (MAE), including stroke, is very low in modern CEA practice, technique-related differences in MAEs in this high-volume procedure may have a very large cumulative effect on disability and resource utilization. Thus, if a clear technique-related advantage (lower rate of MAEs or other outcome) could be demonstrated for one or the other CEA technique, the effect of general adoption of that technique would have the potential of significant reduction in resource utilization.

Most CEAs are performed using a longitudinal arteriotomy extending from the common carotid into the internal carotid artery to facilitate endarterectomy, hereafter termed “conventional” CEA (CCEA); however, an alternative technique performed by dividing the bulb/internal carotid artery to allow an eversion endarterectomy of the distal segment, hereafter termed eversion CEA (ECEA) emerged in the 1990s.[5–7] Results from a number of retrospective and even randomized prospective trials have compared ECEA and CCEA techniques, and both techniques have demonstrated very good results.

However, publications detailing these results have generally come from single centers, or in the case of randomized prospective trials, from vetted centers with a strong specific interest in this area and may not represent outcomes in other centers. Furthermore, most of these prior reports included <2000 patients. Even meta-analyses of these precedent reports have had a limited number of patients; for example, the recent metaanalysis by Cao et al[8] yielded 2589 patients.

The Society for Vascular Surgery (SVS) Vascular Quality Initiative (VQI) database currently includes records from >20,000 CEAs and likely includes data from a broader range of institutions. Thus this VQI database provides an opportunity to compare outcomes after ECEA and CCEA from a unique perspective. We examined results in the VQI database to explore questions pertaining to possible superior results with ECEA vs CCEA.

METHODS

A deidentified data set of all carotid procedures entered in the VQI between January 2003 and July 2013 was obtained and used for this analysis after approval of the SVS Patient Safety Organization Research Advisory Committee and the Cadence Health Institutional Review Board, which waived the requirement for patient informed consent because only deidentified patient data were used. Records were excluded for patients undergoing a second (contralateral) CEA, repeat ipsilateral CEA, CEA after previous ipsilateral carotid stenting, and CEA combined with coronary artery bypass grafting. This left 2365 ECEA (12%) and 17,155 CCEA (88%) for comparison.

Outcome variables examined included periprocedural hemispheric ischemic events, periprocedural death, return to the operating room for bleeding, and operative time along with other patient and procedure-related variables. The null hypothesis was that there would be no difference between ECEA and CCEA with respect to the risk of any primary or secondary outcome measure (see below). The alternative hypothesis was that there would be a difference between ECEA and CCEA with respect to one or more of these primary or secondary outcomes.

Comparisons were made and tests of hypotheses performed using the Wilcoxon rank sum test for continuous variables and the two-sided Fisher exact test or χ^2 (with Yates continuity correction for 2×2 tables) for categorical variables. The size of the data set allowed exploration of the effect of other patient characteristics, including multivariate modeling, as possible predictors of outcome using logistic-regression and Cox proportional hazards models. Covariates with $P < .05$ in univariate testing were included in multivariate models with CEA type (ECEA or CCEA) in all models and with stepwise removal of other variables with $P > .05$ to explore whether patient characteristics other than the choice of ECEA or CCEA had predictive value with respect to the risk of adverse events. Follow-up data were used for survival analysis using life-table methods and Kaplan-Meier estimates.[9] Log-rank tests were used where appropriate.

Not all procedures included 1-year data because of loss to follow-up or death, because data had not been entered by the participating center, and because many procedures had been performed less than 1 year before we obtained the data set. Thus, 1-year data were available for about half of the patients. The Social Security Death Index (SSDI) allows for inclusion of information about late survival even if the patient has not been seen in the office for literally years. We were therefore able to examine survival life tables with data for nearly 10 years after CEA. General analyses and hypothesis testing were performed with SAS 9.4 software (SAS Institute Inc, Cary, NC). Significance was presumed and the null hypothesis was rejected for $P < .05$ for all tests of the hypothesis.

RESULTS

Patient groups were compared with respect to patient characteristics (Table I) and operative details and outcomes (Table II). ECEA and CCEA groups were clearly different with respect to age (ECEA average 1.5 years older). Multiple other comparisons in Table I identify what appear to be statistically significant baseline differences based on standard tests of hypothesis. However, given a data set this large, even a small difference might be "statistically significant"; however, the magnitudes of the differences are small, and few of these differences would seem to be clinically relevant. This includes various indications for surgery, including hemispheric and ocular ischemic events. One possible exception would be urgency of operation, for which there was a slight but significant trend toward more patients requiring urgent surgery for CCEA than for ECEA.

Several differences were apparent with respect to conduct of surgery in the two groups (Table II). For example, use of general anesthesia and use of a shunt were both more frequent with CCEA. No difference was demonstrated for the occurrence of any perioperative ipsilateral neurologic event or perioperative ipsilateral stroke. Analysis of secondary outcomes demonstrated that ECEA took significantly less time (median 15 minutes per case) than did CCEA. About 40% of records were complete with respect to type of patch (if any) used for CCEA. Among those records, comparison of CCEA operative times for no patch, prosthetic patch, or autologous vein patch (Table III) demonstrated that the time required increased with prosthetic and even more with autologous vein patch). However, even with use of a prosthetic patch CCEA, median operative time was 14 minutes more than for ECEA.

The rate of perioperative return to the operating room was greater after ECEA. Some patients were returned to the operating room for reasons other than bleeding alone, but when the test of hypothesis simply compared return to the operating room for bleeding in ECEA (1.4%) vs CCEA (0.8%), this difference was still quite significant ($P = .002$). However, we also noted that protamine was used more often at the time of CCEA than at ECEA and that dextran was used more often after ECEA than after CCEA. We explored differences in the rate of the use of protamine and dextran as possible contributors to the difference in the rate of return to the operating room for bleeding. Logistic regression analysis (Table IV) showed that the use of protamine was a strong independent negative predictor of early return to the operating room for bleeding, but that even after adjusting for differential use of protamine, ECEA was more often associated with an early return to the operating room for bleeding. Several other variables that showed trends toward independent predictive value in univariate testing for early return to surgery for bleeding, for example, use of dextran, any chronic obstructive pulmonary disease, and use of acetylsalicylic acid or $P2Y_{12}$ antagonists, or both, as summarized in Table III, were not independent predictors of return to the operating room for bleeding when protamine use and the type of CEA (ECEA or CCEA) were both included in the logistic model.

Life-table estimated survival of ECEA and CCEA patients was significantly different (log-rank, $P = .01$; Fig), However, estimated survival was similar at 1 year (Table II), Although VQI participants may add data at any time during follow-up, follow-up > 1 year is not required. However, the VQI database incorporates information from the SSDI and is continuously refreshed with these SSDI data so that information is more complete for survival than for other variables for > 1 year of follow-up, Inspection of the Fig shows that survival declined more rapidly in ECEA than in CCEA patients after ~2 to 3 years of follow-up. We hypothesized that this was likely explained to a great extent by the significantly greater age at surgery in the ECEA group. Cox proportional hazards modeling confirmed that in addition to age, independent predictors of mortality included coronary artery disease, chronic obstructive pulmonary disease, and smoking but also demonstrated that CEA type was not an independent predictor of mortality when these other variables were included in the model (Table V).

Later ipsilateral neurologic events were similarly unusual in both groups, as indicated by the similar point estimates of 1-year estimated freedom from ipsilateral neurologic events (Table II). Restenosis from recurrent stenosis >50% was 88.8% for ECEA vs 94.3% for CCEA ($P < .001$). However, 1-year reoperation was similarly rare in the two groups, as indicated by nearly identical estimated freedom from reoperation at 1 year (Table II).

DISCUSSION

DeBakey[10] took credit in 1975 for the first endarterectomy for carotid bifurcation atherosclerosis in 1953, but Lorimer[11] in 1961 was probably the first person to describe an ECEA similar to that typically performed today. Initially, ECEA of the internal carotid was probably used primarily to deal with redundant internal carotid arteries,[12] and most CEAs performed in North America, certainly those performed before the early 1990s, have likely been performed using the "conventional" technique, and this is true for most CEAs in the VQI database. However, ECEA was hypothesized to have advantages over CCEA, for example, a possibly lower restenosis rate, the obviation of need for any patch, shorter operative time, and the ability to easily manage a redundant internal carotid artery, and in the late 1980s or early 1990s, some surgeons transitioned to ECEA as their standard technique.[5,6]

Several centers have published excellent results with ECEA.[7,13–15] These reports have included very favorable results in general and particularly with respect to periprocedural cerebral and retinal ischemic events and mortality. Some have even suggested that use of ECEA may blunt or negate a perceived increase in complications rates seen with CCEA in women.[16,17] Nevertheless, the technique seems to have been more popular in Europe than in North America. For example Menyhei et al[18] reported that 26% of CEA in a multi-national European registry were performed using the eversion technique, and Palombo et al[19] reported an even higher rate of 38% in an Italian registry, whereas only 12% of CEA in the

Vascular Study Group of New England (VSGNE) database were performed using the eversion technique.[20]

In any case, it is fair to say that previously published reports have offered many conflicting conclusions with respect to some relevant outcomes. For example, Kieny et al[5] suggested a lower restenosis rate after ECEA, and Cao et al[21] conducted the Eversion Endarterectomy versus Standard Trial (EVEREST) trial, a randomized prospective comparison of ECEA vs CCEA and found excellent results in the two groups with the apparent lower restenosis rate advantage of ECEA eliminated in the patients undergoing CCEA with a patch closure. However, these results from participating hospitals may not be replicated in all nonparticipating hospitals. For example Goodney et al[20] actually found a greater rate of restenosis >80% (6% vs 2%) for ECEA in VSGNE. They also noted an apparent decline in the use of ECEA over time in the same report, although it is possible that this apparent decline represents inclusion of data from more surgeons and more centers performing CEA over time within the VSGNE. However, as of July 2013,12% of all CEA in the larger VQI database were performed using the eversion technique, identical to the observation of Goodney et al.[20]

We noted a significant difference between groups with respect to anesthetic choice. The choice of anesthetic technique is likely to be related to preferences at the institutions performing each type of procedure, and the precedent literature has made it clear that there is no consistent advantage of one anesthetic technique over another for CEA.[22] With respect to the significant difference in the rate of shunting in the two cohorts, this is also highly dependent on institutional and physician preference, and once again, the extensive precedent literature has provided no clear consensus for the decision to shunt during CEA.[23,24] We observed no significant differences in neurologic outcomes or survival despite the differences between the cohorts, and our observations have reinforced the precedent literature with respect to both of these topics.

The precedent literature has been mixed with respect to the likelihood of restenosis, but the consensus of results, including those from randomized prospective trials, has been that the likelihood of restenosis after ECEA is as favorable as (and certainly no worse than) CCEA. In contrast, our findings demonstrate a higher rate of restenosis in ECEA at 1 year. Of note, the sample size of this data set is on the order of tenfold larger than any prior investigation, including the Cao et al[8] meta-analysis of ECEA vs CCEA. As noted above, our findings arc similar in direction to those of Goodney et al[20] using data from a component of the current data set, although Goodney et al used a standard of >80% recurrent stenosis whereas we used a standard of >50%. However, the post-CEA surveillance imaging standard for this severity of restenosis is not determined by VQI; rather, each participating center may have a different standard for diagnosing recurrent stenosis of this severity. Thus, because the choice to use ECEA is likely to be made in most cases at the institutional level, this higher rate of restenosis after ECEA possibly represents different standards for recurrent stenosis at those institutions.

We would argue that an operationally more relevant comparison is the frequency of need for return to surgery, presumably reflecting the emergence of ipsilateral symptoms or other indications for surgery, beyond the perioperative period. In this latter regard, returns to surgery after the perioperative period for ECEA and CCEA were both unusual and indistinguishable between the two groups in our study. However, because follow-up is limited to 1 year (except for survival), the longer-term significance of this apparently greater risk of recurrent stenosis among ECEA patients is unknown. Another possibility is that some of these ECEAs represent cases early in the ECEA experience of participating surgeons and centers. Unfortunately, the VQI database does not include any data that would allow exploration of how experienced the surgeons and centers were in each type of technique.

The observation that ECEA required shorter operating times than did CCEA is intriguing and suggests a possible way to reduce resource consumption for this commonly performed procedure. Furthermore, the cost of a prosthetic or other nonautologous patch or the cost and morbidity related to harvesting of an autologous patch are eliminated using ECEA. Most CCEAs in this database were performed with a patch, consistent with current consensus best practice.[20] Most of the CEAs performed in the United States are in Medicare patients, for whom the payment for CEA is fixed, so that any decrease in resource utilization may improve the finances of the hospital.

With respect to the possible effect of surgeon environment or experience on the time required to perform CEA, the VQI does not presently allow us to select for teaching vs nonteaching hospitals or to select for cases performed by residents vs attending surgeons. However, as noted above, the risk of requiring an early return to surgery for bleeding was greater after ECEA. The potential time and resource utilization advantage for ECEA may be blunted by an apparent increased likelihood of early return to surgery, primarily for postprocedural bleeding. However, multivariate analysis showed that this may be partly explained by differential use of protamine in the two groups. Stone et al,[25] once again using the VSGNE database, demonstrated that use of protamine is associated with a decreased rate of post-CEA bleeding complications, and Patel et al[26] showed that this information may be used to increase the rate of protamine use and decrease the rate of post-CEA bleeding complications. Thus, this appears to be a possible opportunity to reduce the risk of post-CEA bleeding complications by recommending routine use of protamine after CEA.

This study has a number of limitations worth noting. First, the data set is a nonrandomized retrospective analysis of prospectively collected data. It is likely that ECEAs are concentrated in a few VQI participating centers, and there is an increased risk that the two study samples are different (ie, that any differences in outcomes may be at least partly due to differences in patient samples). However, with few exceptions, examination of patient characteristics in the VQI database did not identify what would seem to be clinically relevant differences in ECEA and CCEA patient samples.

Second, restenosis after CEA may not be apparent until 12 to 18 months after surgery.[21] Because the VQI database predominantly contains only 1-year follow-up, any differences in the longer-term restenosis risk may be underestimated. Furthermore 1-year data were only available for about half of the patients, due to incomplete follow-up data entry by participating centers and to censoring because many CEAs had been performed <1 year before closure of the data set.

Finally the MAE rates for indicators such as stroke and mortality are quite low for CEA studies, and identifying a difference in end points between ECEA and CCEA might be difficult. However, these limitations are balanced by the size of this data set, which increases the power to detect a true difference in outcome of any magnitude. Once again, we are aware of no previous study with a data set of this size combined with the level of detail regarding patient characteristics available in the VQI database.

CONCLUSIONS

ECEA and CCEA both provide a low risk of MAEs including neurologic complications. A significantly shorter operative time for ECEA may represent a financial opportunity. However, this opportunity may be blunted or eliminated by an unexplained higher rate of early return to surgery after ECEA, although this disadvantage may be reduced by routine intraoperative use of protamine to reverse heparin anticoagulation.

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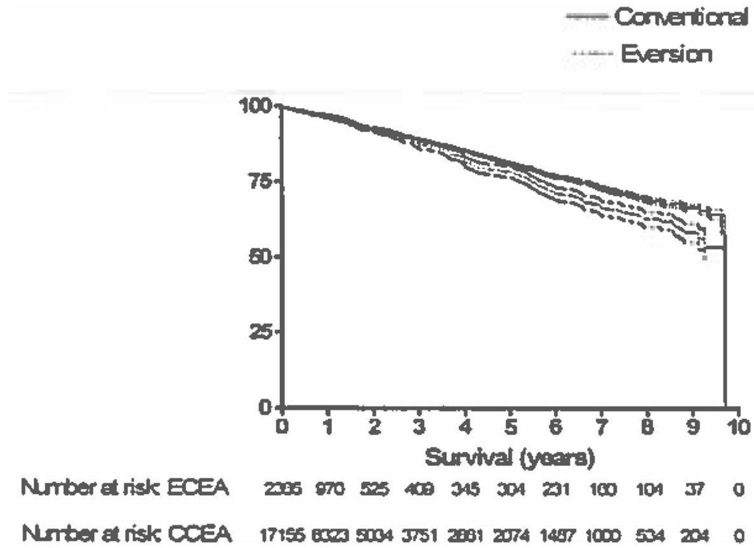

Fig.

Predicted patient survival (%) vs time of follow-up (years) for carotid endarterectomy (CEA). The *upper* and *lower* traces for conventional CEA (*CCEA; black lines*) and eversion CEA (*ECEA; red lines*) represent the standard error of the mean, which never reaches or exceeds 10% for either CEA type.

Table I

Baseline characteristics of patients undergoing conventional (*CCEA*) and eversion carotid endarterectomy (*ECEA*)

Variables[a]	CCEA (n = 17,155)	ECEA (n = 2365)	P[b]
Any prior neurologic event	8142 (47.5)	1097 (46.5)	.37
Age, years	69.8 ± 9.5	71.3 ± 9.4	<.001
Male	10,273 (59.9)	1373 (58.0)	.09
White race	16,159/16,838 (96.0)	2200/2304 (95.5)	.27
Smoking status			.004
Never	4055 (23.7)	616 (26.1)	
Prior	7982 (46.6)	1110 (47.1)	
Current	5095 (29.7)	633 (26.8)	
Hypertension	15061 (87.9)	2078 (88.0)	.89
Diabetes mellitus	5721 (33.4)	775 (32.8)	.59
Coronary artery disease	4894 (28.6)	728 (30.8)	.02
History or CHF	1401 (8.2)	217 (9.2)	.10
COPD	3448 (20.1)	527 (22.3)	.01
On dialysis	138 (0.8)	18 (0.8)	.89
Preoperative living at home	16,936/17,129 (98.9)	2327 (98.6)	.04
Preoperative medications			
Statin	13,199 (76.9)	1786 (75.5)	.09
β-blocker	11,192 (65.3)	1542 (65.5)	.87
Aspirin	16,212 (83.2)	2188 (81.8)	.08
ACE inhibitor	2852 (16.6)	528 (22.2)	<.001
Ipsilateral disease severity ≥70%	15,565 (90.7)	2157 (91.2)	.46
Urgent or emergency procedure	2389 (13.9)	279 (11.8)	.005

ACE, Angiotensin-converting enzyme; *CABG,* coronary artery bypass grafting; *CHF,* congestive heart failure; *COPD,* chronic obstructive pulmonary disease; *PCI,* percutaneous coronary intervention

[a]Continuous variables are shown as mean ± standard deviation and categorical variables as number (%).

[b]*P* calculated using Wilcoxon rank sum, χ^2, or Fisher exact tests.

Table II

Operative details and outcomes

Variables[a]	CCEA (n = 17,155)	ECEA (n = 2365)	P[b]
Local or regional anesthesia	1323 (7.7)	406 (19.5)	<.001
Use of shunt	10,074 (58.9)	577 (24.5)	<.001
Heparin	16,989 (99.1)	2321 (98.5)	.005
Protamine	10,309 (60.2)	1239 (52.6)	<.001
Dextran	2188 (12.8)	429 (18.2)	<.001
Use of drain	4994 (41.6)	645 (35.4)	<.001
Intraoperative monitoring			<.001
Electroencephalography	5454 (31.9)	1041 (44.2)	
Stump pressure	1027 (6.0)	192 (8.1)	
Other	2068 (12.1)	564 (23.9)	
Not stated	8606 (50.2)	568 (24.0)	
Intraoperative completion study			<.001
Doppler	10,210 (59.6)	1026 (43.5)	
Duplex scan	4472 (26.1)	680 (28.8)	
Arteriogram	600 (3.5)	185 (7.8)	
Any new ipsilateral neurologic event	218 (1.3)	29 (1.2)	.86
Any new ipsilateral stroke	152 (0.9)	20 (0.8)	.84
Procedure time, min			<.001
Mean ± SD	121 ± 50	115 ± 57	
Median (IQR)	114 (88–143)	99 (77–135)	
Any postoperative MI	167 (1.0)	23 (01.0)	.99
Any cranial nerve injury	696 (4.1)	97 (4.1)	.91
Perioperative return to operating room			
For a neurologic event	76 (0.4)	10 (0.4)	.89
For bleeding	133 (0.8)	33 (1.4)	.002
Survival point estimate, % (95% CI)			
30-day	99.2 (99.1–99.4)	99.1 (98.5–99.4)	.01
1-year	95.9 (95.5–96.3)	96.7 (95.6–97.7)	.01
Point estimate for 1-year freedom from			
Ipsilateral cortical neurologic event, % (95% CI)	96.7 (96.4–97.1)	96.7 (95.4–97.7)	*c*
Reoperation, % (95% CI)	99.56 (99.37–99.69)	99.46 (98.71–99.78)	*c*
Recurrent ipsilateral carotid stenosis >50%, % (95% CI)	94.3 (93.8–94.8)	88.8 (86.6–90.7)	*c*
Discharged to other than home	893 (5.2)	113 (4.8)	.40

CCEA, Conventional carotid endarterectomy; *CI,* confidence interval; *ECEA,* eversion carotid endarterectomy; *IQR,* interquartile range; *MI,* myocardial infarction; *SD,* standard deviation.

[a] Categorical data are shown as number (%) and continuous data as indicated.

[b] *P* calculated using Wilcoxon rank sum, χ^2. Fisher exact, or log-rank tests.

[c] Point estimates provided for 30 days or 1 year, but log-rank *P* was not calculated for other than survival because data collection > 1 year for other than survival would likely have been highly biased for these other life-table comparisons (see text).

Table III

Comparisons of operative times for conventional carotid endarterectomy (CCEA) depending on use of patch and patch type

		Operative time, minutes	
Patch type	**No.**	**Mean ± SD**	**Median**
None	266	115 ± 81	100
Prosthetic	6188	120 ± 47	113
Autologous vein	157	172 ± 73	158

SD, Standard deviation.

Wilcoxon rank-sum $P < .001$.

Table IV

Results of logistic regression analysis testing the possible predictive value of various independent variables on the likelihood of early return to the operating room for bleeding

	Odds ratio estimates			
Variables	**Point estimate**	**95% Wald confidence limits**		***P* value**
ECEA	1.752	1.191	2.576	.004
Protamine	0.535	0.392	0.730	<.001
Dextran	0.963	0.613	1.513	.87
Any COPD	1.165	0.809	1.679	.41
ASA and/or $P2Y_{12}$ antagonist	0.976	0.615	1.547	.92

ASA, Acetylsalicylic acid; *CI,* confidence limits; *COPD,* chronic obstructive pulmonary disease; *ECEA,* eversion carotid endarterectomy.

Table V

Results of Cox proportional hazards model testing the possible independent predictive value of various independent variables on survival

Variables	Hazard ratio	95% confidence limits		*P* value
Age	1.046	1.035	1.058	<.001
Any pre-CEA ipsilateral cortical stroke	6.589	1.625	26.728	.008
Emergency CEA	2.442	1.418	4.207	.001
Any coronary artery disease	1.439	1.162	1.781	<.001
Any COPD	1.637	1.339	2.001	<.001
Previous smoker	1.288	1.021	1.624	.003
Current smoker	1.408	1.062	1.866	.002
ECEA	0.943	0.694	1.282	.71

CEA, Carotid endarterectomy; *COPD*, chronic obstructive pulmonary disease; *ECEA*, eversion carotid endarterectomy.