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Original Article

Clinical outcomes of modified partial eversion carotid endarterectomy: 27-month follow-up

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Abstract
Aim: This study aimed to evaluate long-term clinical outcomes after Modified Partial Eversion Carotid Endarterectomy (MPE-CEA) and to determine prognostic factors associated with all-cause mortality.
Material and Methods: A retrospective analysis was conducted on 55 consecutive patients aged ≥50 years who underwent MPE-CEA between January 2020 and December 2023 at a single center. The mean follow-up duration was 27 months, with all-cause mortality designated as the primary outcome. Survival was assessed with Kaplan–Meier analysis, while predictors of mortality were examined using Cox proportional hazards models.
Results: The mean age of the patients was 68.45 ± 9.34 years, and 70.9% were male; chronic kidney disease (CKD) was present in 9.1% of patients. No stroke, cranial nerve injury, or in-hospital mortality was observed in the postoperative period, while one patient (1.8%) required surgical revision due to hematoma. According to the survival analysis, the estimated overall survival rates at 3 and 5 years were 82.3% and 70.5%, respectively. The presence of CKD was associated with poorer survival, with a two-year estimated survival of 40% in patients with CKD ($p < 0.001$). In the multivariate analysis, CKD was identified as the only independent predictor of mortality (HR: 10.446; 95% CI: 1.257–86.777; $p = 0.030$).
Conclusion: MPE-CEA was associated with low perioperative complication rates in this cohort. Chronic kidney disease emerged as the only independent predictor of long-term all-cause mortality, identifying a high-risk subgroup that may require closer multidisciplinary follow-up.

Keywords: Carotid endarterectomy, modified partial eversion, chronic kidney disease, all-cause mortality, prognostic factor

INTRODUCTION

Carotid artery disease represents a major vascular pathology in which atherosclerotic plaque formation within the carotid arteries leads to partial or complete narrowing of the arterial lumen, resulting in impaired cerebral perfusion. Worldwide, carotid artery disease accounts for a significant proportion of ischemic stroke cases and represents an important cause of both death and long-term disability. Approximately 15 million stroke cases occur worldwide each year, with significant consequences for both individuals and healthcare systems. According to current estimates, approximately 816 million people are affected by CAD to varying degrees, and based on the NASCET criteria, approximately 58 million individuals are predicted to have clinically significant carotid artery stenosis [1,2]. In particular, carotid stenosis exceeding 70% in symptomatic patients increases the annual stroke risk by up to 13%, making early diagnosis and determination of appropriate treatment approaches crucial in this patient group [3].

Management of carotid artery disease is guided by both the severity of arterial narrowing and the patient's clinical profile. Available therapeutic options range from optimal medical therapy to endovascular intervention with carotid artery stenting and open surgical treatment with carotid endarterectomy. Evidence from contemporary studies indicates that carotid endarterectomy provides the greatest reduction in stroke risk, particularly among patients with severe carotid stenosis [4]. Two main surgical

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techniques are primarily used in CEA: conventional (traditional) endarterectomy and eversion endarterectomy [5]. In recent years, studies on modifications of these techniques have gained momentum with the aim of increasing surgical success and reducing perioperative complications.

Modified Partial Eversion Carotid Endarterectomy (MPE-CEA) has previously been described in the literature as a technical variation of carotid endarterectomy [6,7]. While earlier studies have mainly focused on the technical aspects of the procedure and short-term outcomes, data on longer-term clinical outcomes after MPE-CEA remain limited. Therefore, the aim of the present study was not to re-establish the novelty of the technique or to compare it with conventional carotid endarterectomy, but rather to evaluate long-term clinical outcomes in patients who underwent MPE-CEA and to investigate patient-related factors associated with overall survival.

MATERIAL AND METHODS

Study Design and Patient Selection

This study has a retrospective and observational design and includes consecutive patients who underwent carotid endarterectomy at the Department of Cardiovascular Surgery, Faculty of Medicine, Adnan Menderes University, between January 2020 and December 2023. The study protocol received approval from the Aydın Adnan Menderes University Non-Interventional Research Ethics Committee (Decision No: 2020/103, dated October 15, 2020).

The inclusion criteria for the study were defined as being 50 years of age or older, having an indication for surgical treatment due to carotid artery stenosis, and having at least 12 months of clinical follow-up data available. Patients with a history of bilateral carotid surgery and cases with incomplete clinical, surgical, or follow-up data were excluded from the study.

Surgical Technique

All procedures were performed by the same experienced surgical team using the Modified Partial Eversion Carotid Endarterectomy (MPE-CEA) technique under general anesthesia through a standard cervical incision. Throughout the procedure, routine cerebral perfusion monitoring was performed using near-infrared spectroscopy (NIRS), whereas EEG monitoring was not used. Preoperative computed tomography imaging was also reviewed with particular attention to the posterior cerebral circulation. This evaluation was used to estimate the potential adequacy of collateral cerebral perfusion during carotid cross-clamping and to support intraoperative assessment of cerebral blood supply. After exposure of the carotid bifurcation, the common, internal, and external carotid arteries were carefully dissected and controlled with atraumatic vascular clamps. Intraluminal shunting was not routinely used. An oblique arteriotomy was made across the carotid bifurcation, extending from the external carotid artery ostial region toward the common carotid artery and incorporating the carotid bulb and internal carotid artery origin (Figure 1).

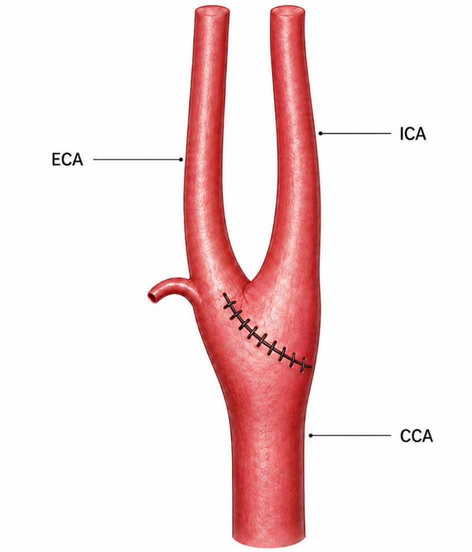

Figure 1. Schematic illustration of the modified partial eversion carotid endarterectomy technique; The oblique bifurcation-based arteriotomy extending from the external carotid artery ostial region toward the common carotid artery is demonstrated; The common carotid artery, internal carotid artery, and external carotid artery are indicated with arrows; CCA: common carotid artery, ICA: internal carotid artery, ECA: external carotid artery

In this modified partial eversion technique, the arteriotomy differs from both conventional longitudinal CEA and standard eversion CEA. Unlike conventional CEA, a long longitudinal arteriotomy extending along the internal carotid artery is not performed. Unlike standard eversion CEA, the internal carotid artery is not completely transected at its origin. Instead, an oblique bifurcation-based arteriotomy is created from the external carotid artery ostial region toward the common carotid artery, incorporating the carotid bulb and the origin of the internal carotid artery. This approach permits partial eversion and controlled plaque extraction at the carotid bifurcation while preserving the continuity of the internal carotid artery.

The atherosclerotic plaque was then meticulously dissected from the intima-media plane using an appropriate spatula. Partial eversion was applied to obtain a smooth tapering distal endpoint in the internal carotid artery and to restore the vascular lumen in a controlled manner. Before closure, the lumen was flushed, and back-bleeding was confirmed. The arteriotomy was then closed primarily with 6/0 polypropylene suture without patch angioplasty. Primary closure was preferred in accordance with the standard surgical practice of our team for this modified technique, with the aim of preserving procedural simplicity and avoiding additional patch-related manipulation. In the immediate postoperative period, all patients were extubated in the operating room and transferred to the intensive care unit for close hemodynamic and neurological monitoring. During the early postoperative period, patients were regularly evaluated for neurological deficits, cranial nerve injury, cervical hematoma, and stroke.

Data Collection and Variables

Demographic data (age and gender) were recorded for the patients, along with hypertension, coronary artery disease, chronic kidney disease, chronic obstructive pulmonary disease, peripheral artery disease, and contralateral carotid artery status (presence of stenosis or occlusion). In addition, medical treatments used during the preoperative and postoperative periods (acetylsalicylic acid, clopidogrel) and perioperative and postoperative complications were evaluated. All-cause mortality during the follow-up period was defined as the primary endpoint of the study.

Statistical Analysis

Statistical evaluation of the study data was carried out using IBM SPSS Statistics software (version 25.0; IBM Corp., Armonk, NY, USA). Numerical variables were summarized using mean values with corresponding standard deviations, whereas qualitative variables were described as absolute numbers along with their relative frequencies. Overall survival outcomes were assessed by constructing Kaplan–Meier survival estimates, and differences between patient groups were examined using the log-rank test. To explore variables associated with mortality, Cox proportional hazards regression analysis was initially applied on a univariate basis. Factors demonstrating a significant association with mortality in univariate analysis were subsequently incorporated into a multivariate Cox regression model to identify independent predictors. All hypothesis tests were conducted using two-sided significance levels, with statistical significance defined as a p-value below 0.05.

RESULTS

A total of 55 patients were included in the study. The mean age of the patients was 68.45 ± 9.34 years, and 39 (70.9%) were male, and 16 (29.1%) were female. The mean age of patients in the group with mortality was statistically significantly higher than that of surviving patients (p = 0.018). Thirty-seven patients (67.3%) had symptomatic carotid artery disease. In the evaluation of the contralateral carotid artery, total occlusion was detected in 5 patients (9.1%), while varying degrees of stenosis were detected in 34 patients (61.8%). The most common comorbid condition was hypertension, which was present in 43 patients (78.2%). Chronic kidney disease (CKD) was present in 9.1% of patients, and a statistically significant difference in CKD prevalence was found between the groups (p = 0.001). Regarding antiplatelet therapy, the rate of acetylsalicylic acid use was 80%, while clopidogrel use was 94.5%. The demographic and clinical characteristics of the patients and their distribution according to groups are presented in Table 1.

Table 1. Comparison of baseline demographic and clinical characteristics between survival and mortality groups

Variable		Mortality (n = 7)	Survival (n = 48)	Total (n = 55)	p value
Age		76.14 ± 9.04	67.33 ± 8.93	68.45 ± 9.34	**0.018***
Gender	**Male**	6 (85.7)	33 (68.8)	39 (70.9)	0.356
	Female	1 (14.3)	15 (31.3)	16 (29.1)	
Hypertension		6 (85.7)	37 (86)	43 (78.2)	0.605
Diabetes mellitus		4 (57.1)	25(52.1)	29 (52.7)	0.802
Coronary artery disease		4 (57.1)	13 (27.1)	17 (30.9)	0.108
Smoking		5 (71.4)	17 (35.4)	22 (40)	0.069
COPD		0 (0)	2 (4.2)	2 (3.6)	0.582
CKD		4 (57.1)	1 (2.1)	5 (9.1)	**<0.001**
PAD		3 (42.9)	7 (14.6)	10 (18.2)	0.07
Contralateral occlusion		2 (28.5)	3 (6.3)	5 (9.1)	0.055
Contralateral stenosis		5 (71.4)	29 (60.4)	34 (61.8)	0.575
Symptomatic		4 (57.1)	33 (48)	37 (67.3)	0.541
ASA		4 (57.1)	40 (83.3)	44 (80)	0.106
Clopidogrel		7 (100)	45 (93.8)	52 (94.5)	0.496
Insulin		2 (28.6)	11 (22.9)	13 (23.6)	0.742
Warfarin		0 (0)	1 (2.1)	1 (1.8)	0.700
DOACs		-	-	-	-

COPD: chronic obstructive pulmonary disease; CKD: chronic kidney disease; PAD: peripheral arterial disease; ASA: acetylsalicylic acid; DOACs: direct oral anticoagulants

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The relationship between comorbidities and other categorical variables and all-cause mortality during the follow-up period was evaluated using Kaplan–Meier survival analysis, and the results are summarized in Table 2. The analyses revealed that coronary artery disease, chronic kidney disease, and contralateral carotid artery occlusion had a negative effect on survival. These variables were found to be statistically significantly associated with mortality ($p = 0.041$, $p < 0.001$, and $p = 0.021$, respectively).

Table 2. Kaplan–Meier analysis of all-cause mortality stratified by categorical variables

Variable	Mean (95% CI)	p value
Gender		
Male	60.680 (48.882 - 72.477)	0.338
Female	60.33 (51.576 - 69.091)	
Hypertension		
(+)	63.519 (54.030 - 73.008)	0.530
(-)	53.917 (46.254 - 61.579)	
Diabetes mellitus		
(+)	65.470 (55.275 - 75.664)	0.996
(-)	56.834 (48.740 - 64.928)	
CAD		
(+)	46.154 (32.063 - 60.246)	**0.041**
(-)	69.086 (60.853 - 77.319)	
Smoking		
(+)	58.391 (45.209 - 71.175)	0.136
(-)	60.884 (55.398 - 66.371)	
CKD		
(+)	23 (15.673 - 30.327)	**<0.001**
(-)	70.894 (64.212 - 77.677)	
PAD		
(+)	57.626 (40.559 - 74.691)	0.238
(-)	58.745 (52.970 - 64.520)	
Contralateral occlusion		
(+)	26 (17.186 - 34.814)	**0.021**
(-)	67.522 (59.792 - 75.253)	
Contralateral stenosis		
(+)	63.383 (52.651 - 74.116)	0.393
(-)	67.737 (57.568 - 77.905)	
Symptomatic		
(+)	66.499 (57.071 - 75.927)	0.809
(-)	54.979 (45.931 - 64.027)	
ASA		
(+)	61.120 (47.377 - 74.862)	0.623
(-)	62.023 (47.593 - 76.453)	
Insulin		
(+)	31.733 (27.008 - 36.459)	0.498
(-)	66.639 (58.347 - 74.932)	

CI: confidence interval; CAD: coronary artery disease; CKD: chronic kidney disease; PAD: peripheral arterial disease; ASA: acetylsalicylic acid

In the univariate Cox proportional hazards regression analysis, age, chronic kidney disease, and contralateral carotid artery occlusion were identified as factors associated with mortality during follow-up ($p = 0.020$, $p < 0.001$, and $p = 0.041$, respectively). In the multivariate Cox regression analysis including these variables, only chronic kidney disease retained its statistical significance as an independent predictor of mortality ($p = 0.030$) (Table 3).

Table 3. Univariate and multivariate cox regression analyses of factors associated with mortality during follow-up

Variable	Univariate		Multivariate	
	HR (95% CI)	p value	HR (95% CI)	p value
Age	1.108 (1.013 - 1.213)	**0.020**	1.051 (0.948 - 1.165)	0.342
CAD	4.278 (0.941 - 19.444)	0.060		
CKD	19.933 (3.540 - 112.229)	**< 0.001**	10.446 (1.257 - 86.777)	**0.030**
Contralateral occlusion	5.979 (1.073 - 33.297)	**0.041**	1.612 (0.237 - 10.954)	0.325

HR: hazard ratio; CI: confidence interval; CAD: coronary artery disease; CKD: chronic kidney disease

When surgical data were evaluated, the mean clamp time was found to be 16 minutes, and the mean postoperative hospital stay was calculated as 3 days. No in-hospital mortality was observed. One patient (1.8%) required surgical revision due to a hematoma that developed in the postoperative period. No cranial nerve damage was detected in any patient in the postoperative period.

During the average follow-up period of 27 months, a total of 7 patients (12.7%) died. According to the Kaplan–Meier survival analysis, the estimated overall survival rate was calculated as 82.3% at 3 years and 70.5% at 5 years (Figure 2). Although Kaplan–Meier analysis permits estimation of survival probabilities beyond the mean observed follow-up, the 5-year survival estimate should be interpreted cautiously because the number of patients remaining at risk at later time points was limited. Survival was significantly worse in patients with chronic kidney disease; the estimated 2-year survival rate in this group was 40% ($p < 0.001$) (Figure 3).

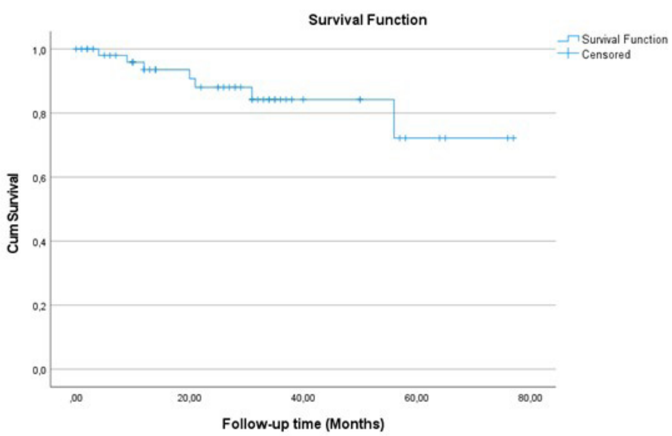

Figure 2. Overall survival analysis performed using Kaplan–Meier method

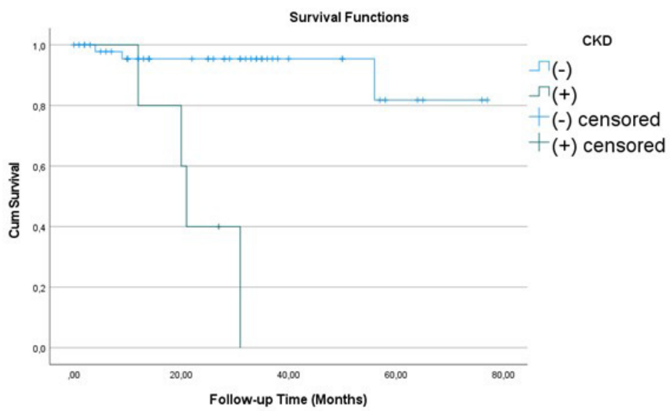

Figure 3. Survival analysis by CKD status using Kaplan–Meier method

DISCUSSION

In this study, long-term survival outcomes were evaluated in patients who underwent Modified Partial Eversion Carotid Endarterectomy (MPE-CEA), and chronic kidney disease (CKD) was shown to be the most important independent predictor of mortality. During an average follow-up period of 27 months, the overall mortality rate was found to be 12.7%, and according to Kaplan–Meier analysis, the estimated overall survival rates were calculated as 82.3% at three years and 70.5% at five years. The absence of mortality in the early postoperative period, the need for surgical revision due to hematoma in only one patient (1.8%), and the absence of cranial nerve injury support the safety and feasibility of the MPE-CEA technique in the early postoperative period. These findings suggest that MPE-CEA can be performed with low perioperative complication rates in this single-center cohort.

Although advanced age, contralateral carotid artery occlusion, and chronic kidney disease were associated with mortality in univariate analyses, chronic kidney disease remained the only variable that retained statistical significance in the multivariate Cox regression model. This finding suggests that renal dysfunction may have an important influence on long-term outcomes following vascular surgical procedures. While advanced age and contralateral occlusion are well-recognized markers of increased cardiovascular risk, their lack of independent significance in multivariate analysis suggests that chronic kidney disease may exert a stronger prognostic effect than other baseline clinical characteristics in this patient population.

An important clinical implication of our findings is that even non-dialysis-dependent chronic kidney disease was associated with markedly reduced long-term survival. This suggests that the prognostic burden of renal dysfunction in patients undergoing carotid surgery may begin well before end-stage renal disease develops. Therefore, CKD should not be viewed merely as a comorbidity, but rather as a marker of systemic vascular vulnerability requiring closer postoperative surveillance and more comprehensive cardiovascular risk optimization.

Previous studies have demonstrated that chronic kidney disease accelerates atherosclerotic progression, disrupts endothelial function, and promotes a chronic inflammatory state [8,9]. Moreover, the accumulation of uremic toxins, increased oxidative stress, and persistent activation of proinflammatory cytokine pathways contribute to vascular stiffness and premature vascular aging [10,11]. These mechanisms collectively increase susceptibility to adverse cardiovascular and cerebrovascular events, particularly in the perioperative and long-term follow-up periods. The results of the present study are consistent with earlier reports identifying chronic kidney disease as a major risk factor for mortality after carotid surgery. This unfavorable effect is likely related to the combined impact of the systemic uremic environment associated with renal dysfunction and the local vascular remodeling processes induced by surgical intervention.

The perioperative outcomes observed in this study are consistent with current international guidelines and previously published large-scale clinical trial data [12–14]. The absence of cranial nerve injury and the low rate of surgical revision indicate that MPE-CEA can be performed safely in appropriately selected patients when carried out by experienced surgical teams. These favorable findings may be partly attributed to the technical characteristics of the MPE-CEA procedure, which allow for reduced arterial manipulation and more controlled plaque excision.

In the present series, arteriotomy closure was performed primarily without patch angioplasty. Because this modified approach does not involve a conventional longitudinal arteriotomy extending along the internal carotid artery, patch angioplasty was not routinely used ,and primary closure was preferred in accordance with the standard surgical practice of our team. Although patch closure is an established option in carotid surgery and may offer advantages in selected settings, our study was not designed to compare primary closure with patch-based or conventional carotid endarterectomy techniques. Therefore, no conclusion can be drawn regarding the relative superiority of this closure strategy, and our findings should be interpreted as descriptive outcome data for a specific surgical approach applied in a single-center cohort. Importantly, because restenosis data were not systematically available during follow-up, the potential relationship between primary closure without patch angioplasty and restenosis could not be evaluated in the present study. Therefore, the absence of patch use should not be interpreted as evidence of equivalent restenosis risk compared with patch closure or other carotid endarterectomy techniques.

The present study was not designed to establish that MPE-CEA is superior to conventional carotid endarterectomy. Nevertheless, this technique may be considered a practical option in selected patients because it allows direct plaque removal through a modified bifurcation-based arteriotomy and is associated with low perioperative complication rates in our cohort. However, this potential procedural rationale should be interpreted cautiously, as no comparative analysis was performed. From a technical perspective, MPE-CEA may be considered an intermediate modification between conventional longitudinal CEA and standard eversion CEA, because it avoids both a long internal carotid artery arteriotomy and complete transection of the internal carotid artery.

Shorter carotid artery clamping times have been shown to be associated with a lower risk of cerebral ischemic complications [6]. The mean clamp time in our cohort was 16 minutes. Although shorter carotid clamping times have been associated with lower ischemic risk in previous reports, our study did not include a direct comparison with other carotid endarterectomy techniques. Therefore, this finding should be interpreted as a descriptive procedural observation rather than definitive evidence of technical superiority.

Notably, the two-year survival rate among patients with chronic kidney disease in the present cohort was only 40%, a finding that aligns with previous evidence identifying renal dysfunction as one of the most influential determinants of prognosis after carotid endarterectomy. This adverse survival outcome cannot be explained solely by the surgical approach; rather, it likely reflects the systemic effects of chronic kidney disease on perioperative vulnerability and long-term cardiovascular health. Numerous studies have similarly demonstrated that chronic kidney disease independently increases the risk of perioperative morbidity and mortality following vascular interventions [15–17].

Contemporary evidence has further highlighted the importance of careful patient selection in carotid revascularization. Current guideline-based management emphasizes an individualized approach based on symptom status, stenosis severity, comorbidity burden, and overall procedural risk [13]. In addition, recent data from the CREST-2 program have renewed the discussion regarding the role of carotid revascularization in the era of intensive medical therapy, particularly in patients with asymptomatic high-grade carotid stenosis [18]. In this evolving context, outcome data from specific surgical approaches should be interpreted within a broader framework of individualized decision-making rather than procedural preference alone.

Given these findings, careful perioperative risk stratification and close postoperative surveillance are particularly important in patients with chronic kidney disease undergoing carotid surgery. A multidisciplinary management approach involving vascular surgery, nephrology, and cardiology services may be beneficial in optimizing outcomes in this high-risk population. Further prospective studies with larger sample sizes and extended follow-up durations are warranted to better clarify the interaction between renal dysfunction, surgical technique, and long-term survival after carotid endarterectomy.

It should also be emphasized that the present study primarily evaluates overall survival rather than procedure-specific long-term durability. Because systematic follow-up data on restenosis, ipsilateral stroke, and reintervention were not available for all patients, the long-term effectiveness of MPE-CEA in preventing recurrent cerebrovascular or carotid-related events could not be assessed. Therefore, the favorable perioperative findings should not be extrapolated to long-term anatomical or neurological durability.

Limitations

This study has several limitations. First, its single-center retrospective design and relatively small sample size limit both statistical power and generalizability. In addition, the limited sample size may partly reflect the selective use of the MPE-CEA technique in our surgical practice. Specifically, this technique was generally preferred in anatomically suitable patients, particularly those without very long plaque extension into the internal carotid artery. Therefore, the study population represents a selected subgroup rather than the full spectrum of patients undergoing carotid endarterectomy. Second, the low number of mortality events resulted in wide confidence intervals, particularly in the multivariable model, and therefore the identified associations should be interpreted with caution. Third, because the study did not include a comparison group treated with conventional carotid endarterectomy or other alternative techniques, no comparative conclusion can be drawn regarding procedural superiority or relative efficacy, and the potential for selection bias regarding the choice of surgical approach cannot be excluded. In addition, clinically relevant long-term outcomes such as stroke recurrence, restenosis, and re-intervention were not systematically available for all patients and therefore could not be analyzed in the present study. Finally, the lack of detailed cause-of-death data limited our ability to further explore the mechanisms underlying the observed association between chronic kidney disease and long-term mortality.

CONCLUSION

Modified Partial Eversion Carotid Endarterectomy appears to be a safe surgical technique with low perioperative complication rates in this single-center cohort. Chronic kidney disease was the only independent predictor of long-term all-cause mortality, suggesting that patients with CKD represent a particularly high-risk subgroup who may benefit from closer multidisciplinary follow-up. Larger prospective studies are needed to confirm these findings.

Ethics Committee Approval: Ethical approval for the study was obtained from the Aydın Adnan Menderes University Ethics Committee on October 15, 2020, under the decision number 2020/103.

Patient Consent for Publication: This study was conducted in accordance with the Declaration of Helsinki. Due to the retrospective nature of the study, informed consent forms were waived. Confidentiality of personal data was meticulously protected, and patient identities were anonymized.

Data Sharing Statement: The data that support the findings of this study are available from the corresponding author upon reasonable request.

Author Contributions: All authors contributed equally to the article.

Conflict of Interest: The authors declared no conflicts of interest with respect to the authorship and/or publication of this article.

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REFERENCES

1. Song P, Fang Z, Wang H, Cai Y, Rahimi K, Zhu Y, et al. Global and regional prevalence, burden, and risk factors for carotid atherosclerosis: a systematic review, meta-analysis, and modelling study. Lancet Glob Health. 2020;8:e721-9.
2. Paraskevas KI. Carotid artery stenosis and stroke: controversies in prevention and treatment. Ann Transl Med. 2021;9:1200.
3. Sudheer P, Vibha D, Misra S. Asymptomatic carotid stenosis: several guidelines with unclear answers. Ann Indian Acad Neurol. 2022;25:171-6.
4. Kedev S. Carotid artery interventions - endarterectomy versus stenting. AsiaIntervention. 2023;9:172-9.
5. Cao PG, de Rango P, Zannetti S, Giordano G, Ricci S, Celani MG. Eversion versus conventional carotid endarterectomy for preventing stroke. Cochrane Database Syst Rev. 2001;2000:CD001921.

6. McBride R, Porter J, Al-Khaffaf H. The modified operative technique of partial eversion carotid endarterectomy. J Vasc Surg. 2017;65:263-6.

7. Zhang X, Bai X, Feng Y, Zhang Y, Yang R, Yang Y, et al. Modified eversion carotid endarterectomy: a novel surgical technique for carotid artery stenosis treatment. Neurol India. 2022;70:1787-92.

8. Liu Y, Li Z, Xu Y, Mao H, Huang N. Uric acid and atherosclerosis in patients with chronic kidney disease: recent progress, mechanisms, and prospect. Kidney Dis (Basel). 2025;11:112-27.

9. Diaz-Ricart M, Torramade-Moix S, Pascual G, Palomo M, Moreno-Castaño AB, Martinez-Sanchez J, et al. Endothelial damage, inflammation and immunity in chronic kidney disease. Toxins (Basel). 2020;12:361.

10. Chermiti R, Burtey S, Dou L. Role of uremic toxins in vascular inflammation associated with chronic kidney disease. J Clin Med. 2024;13:7149.

11. Tonelli M, Karumanchi SA, Thadhani R. Epidemiology and mechanisms of uremia-related cardiovascular disease. Circulation. 2016;133:518-36.

12. Barnett HJM, Taylor DW, Sackett DL, Peerless SJ, et al.; 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.

13. Naylor AR, Ricco JB, de Borst GJ, Debus S, de Haro J, Halliday A, et al. Editor's Choice - Management of Atherosclerotic Carotid and Vertebral Artery Disease: 2017 Clinical Practice Guidelines of the European Society for Vascular Surgery (ESVS). Eur J Vasc Endovasc Surg. 2018;55:3-81.

14. Mazzolai L, Teixido-Tura G, Lanzi S, Boc V, Bossone E, Brodmann M, et al. 2024 ESC Guidelines for the management of peripheral arterial and aortic diseases. Eur Heart J. 2024;45:3538-700.

15. Tall AA, Zil-E-Ali A, Paracha AW, Choi ES, Abdeen A, Aziz F. Meta-analysis investigating the association between the degree of chronic kidney disease and outcomes of carotid endarterectomy in symptomatic and asymptomatic carotid artery stenosis. Ann Vasc Surg. 2025;121:201-16.

16. Blecha M, DeJong M, Carlson K. Risk factors for mortality within 5 years of carotid endarterectomy for asymptomatic stenosis. J Vasc Surg. 2022;75:1945-57.

17. Jeong MJ, Byun E, Chang JW, Kwon SU, Kim N, Choi E, et al. Impact of chronic kidney disease under nephrology care on outcomes of carotid endarterectomy. Eur J Vasc Endovasc Surg. 2021;61:739-46.

18. Brott TG, Howard G, Lal BK, Voeks JH, Turan TN, Roubin GS, et al; CREST-2 Investigators. Medical management and revascularization for asymptomatic carotid stenosis. N Engl J Med. 2026;394:219-31.