Electronic Journal of General Medicine
2024, 21(3), em587
e-ISSN: 2516-3507
https://www.ejgm.co.uk/

MODESTUM

Original Article

OPEN ACCESS

Primary versus patch closure after carotid endarterectomy: A retrospective study

Nehal Farouk [1]*, Ehab M Abdo [1], Sameh E Elimam [1], Waleed E Elshinawy [1], Abdelaziz A Abdelhafez [1], Lobna Kh Sakr [2], Walaa Husein Abdo [2], Hayam Abdel-Tawab [3], Eman A Elhamrawy [3], Sahar Fares Ahmed [3], Shymaa Adel Ismael [4], Mahmoud Kamel Elawady [4], Samy Ibrahim Kamel [4], Rehab Elsheikh [5], Ayman Osama [6]

[1] Department of Vascular Surgery, Faculty of Medicine, Al-Azhar University, Cairo, EGYPT
[2] Department of Radiology, Faculty of Medicine, Al-Azhar University, Cairo, EGYPT
[3] Department of Neurology, Faculty of Medicine, Al-Azhar University, Cairo, EGYPT
[4] Department of Neurosurgery, Faculty of Medicine, Al-Azhar University, Cairo, EGYPT
[5] Department of Radiology Imaging Technology, Faculty of Applied Health Sciences, Misr University for Sciences and Technology, Cairo, EGYPT
[6] Department of Radiodiagnosis & Intervention, Faculty of Medicine, Helwan University, Cairo, EGYPT
*Corresponding Author: Dr.nehalfarouk@yahoo.com

Citation: Farouk N, Abdo EM, Elimam SE, Elshinawy WE, Abdelhafez AA, Sakr LK, Abdo WH, Abdel-Tawab H, Elhamrawy EA, Ahmed SF, Ismael SA, Elawady MK, Kamel SI, Elsheikh R, Osama A. Primary versus patch closure after carotid endarterectomy: A retrospective study. Electron J Gen Med. 2024;21(3):em587. https://doi.org/10.29333/ejgm/14596

ARTICLE INFO

Received: 10 Oct. 2023

Accepted: 17 Apr. 2024

ABSTRACT

Purpose: The present study aimed to provide our experience with patch closure (PAC) and primary closure (PRC) after carotid endarterectomy (CEA).

Materials & methods: The present retrospective comparative study included 106 patients submitted to elective CEA. They comprised 50 patients in PRC group and 56 patients in PAC group. Patients were followed perioperatively, at three months and at one year for surgical complications, stroke, and restenosis.

Results: Postoperatively, no significant differences were found between the studied groups regarding rates of stroke (6.0% versus 3.6%, p=0.740), infection (0.0% versus 3.6%, p=0.520), hematoma (2.0% versus 1.8%, p=0.940), pseudoaneurysm (0.0% versus 3.6%, p=0.520), cranial nerve injury (2.0% versus 1.8%, p=0.940), and cardiac events (2.0% versus 1.8%, p=0.940). At three months, three patients in PRC group and four in PAC group were lost to follow up. No significant differences were found between the studied groups regarding rate of restenosis at three months (2.1% versus 0.0%, p=0.960). At one year, patients in PRC group experienced significantly higher rate of restenosis (14.9% versus 1.9%, p=0.046). None of the studied patients died.

Conclusions: CEA combined with patch angioplasty may be associated with lower restenosis rate.

Keywords: carotid artery disease, carotid endarterectomy, primary closure, patch closure

INTRODUCTION

Carotid artery disease (CAD) has been suggested as a cause of ischemic stroke in 15.0-20.0% of cases. Globally, CAD is associated with significant morbidity and mortality burden. Available management options entail medical, surgical, and endovascular strategies [1]. Despite the significant progress achieved in management of CAD patients, multiple uncertainties do still exist particularly appropriate selection of surgical intervention in asymptomatic cases [2].

For almost 70 years, carotid endarterectomy (CEA) has been considered for management of CAD. Surgical techniques have evolved over the years and currently, there are many variations among surgical practices worldwide. After CEA, the commonly used vascular closure procedures include patch closure (PAC) and primary closure (PRC) [3].

However, choice of the optimal closure technique remains debatable with inconsistent conclusions derived from systematic reviews and meta-analyses [4]. In one work, based on moderate-quality evidence, it was suggested that PAC was associated with lower perioperative stroke and restenosis [5]. In another review, it was supported PAC as a superior technique to PRC with level I evidence [6]. In contrast, it was argued that there is no conclusive evidence indicative of a difference between PAC and PRC regarding 30-day stroke, mortality, or other serious adverse events [7]. While the recent meta-analysis in [8] concluded that PAC may be associated with lower short and long-term risk of stroke and restenosis, they noted that evidence lacks certainty due to the imperfect quality of most included studies.

The present study aimed to contribute to this debate by providing our experience with PAC and PRC after CEA.

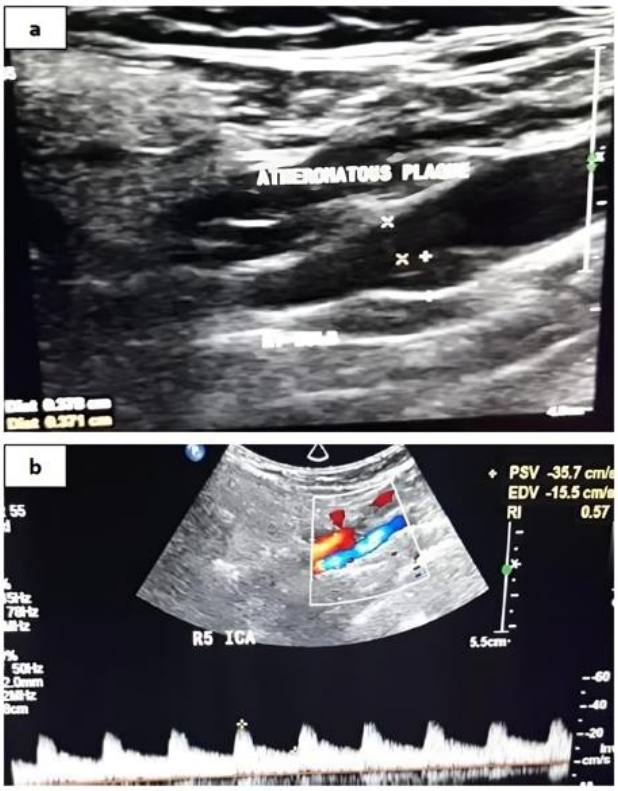

Figure 1. Doppler ultrasound examination: (a) B-mode Doppler ultrasound examination revealed moderate stenosis of right internal carotid artery by an atheromatous plaque; (b) color Doppler ultrasound examination of right internal carotid artery after endarterectomy showing color flow with average PSV & EDV (reprinted with permission of the patient)

MATERIALS & METHODS

The present retrospective comparative study protocol was approved by the ethical committee. The study included 106 patients who submitted to elective CEA between June 2018 and June 2020. They comprised 50 patients in PRC group and 56 patients in PAC group at Al-Azhar University Hospitals.

Preoperatively, all patients were evaluated with duplex ultrasound. Internal carotid artery (ICA)/common carotid artery peak systolic velocity ratios were employed to measure the degree of carotid stenosis. Carotid artery stenosis was classified as mild if the ratio was between 0.1 and 1.9, moderate if the ratio was between 2.0 and 4.0, and severe if the ratio was greater than four (**Figure 1**).

A computed tomography angiogram or magnetic resonance angiogram were scheduled when the carotid artery stenosis reached 70.0% in asymptomatic cases and 50.0% in symptomatic patients, and eventually, CEA was conducted after gaining consent from the patients or their families.

CEA was conducted under general anesthesia utilizing conventional surgical techniques and recommendations. Preoperative findings like the clinical history, backpressure readings, and intraoperative electroencephalogram data guided the decision to do carotid shunting. Small ICA diameter (five mm), lengthy arteriotomy (extending more than three cm beyond ICA's origin), and kinked or looped ICA requiring resection were all criteria for obligatory PAC. Vein patches (saphenous or neck veins) and synthetic patches (dacron or polytetrafluoroethylene) were utilized as patch materials. After the procedure, cases were moved to the recovery unit for monitoring after surgery, with a maximum systolic blood pressure threshold of 150 to 160 mmHg. Patients were then monitored for 24 hours in the intensive care unit and transferred to the ward after systolic blood pressure remained less than the threshold for at least four hours. All patients were advised to be mobilized early on the first postoperative day.

The findings of doppler ultrasound scans for restenosis and complication assessment were compared to preoperative stenotic values at the following intervals: immediate (within seven days of CEA), three months, and one year. The operating team had consulted a stroke neurologist for additional evaluation of the patient if neurological issues were suspected. From the first day postoperative until discharge from hospital, all patients were given low molecular weight heparin on their body weight. After being discharged from hospital, all patients continued to take 75 mg clopidogrel, 100 mg acetylsalicylic acid, and 20 mg atorvastatin for at least six months.

The statistical program for social sciences, version 23.0, was utilized for data analysis. When comparing two means, the independent-samples t-test of significance was utilized. To compare proportions among qualitative factors, a Chi-square test of significance was performed. p-value less than 0.050 was considered statistically significant.

RESULTS

The present study included 106 patients submitted to CEA for CAD. They comprised 50 patients with PRC and 56 patients with PAC. Comparison between the studied groups regarding age, associated comorbidities, clinical history data, operative side and need for shunting revealed no statistically significant differences. However, PRC group included significantly higher frequency of males (74.0% versus 41.1%, p<0.001) (**Table 1**).

Table 1. Baseline characteristics in studied groups

Variables	PRC (n=50)	PAC (n=56)	p
Female/male: n	13/37	33/23	0.001
Age (years): Mean±SD	65.9 ± 7.7	65.6±6.5	0.800
Comorbidities: n (%)			
DM	23 (46.0)	29 (51.8)	0.550
HTN	25 (50.0)	34 (60.7)	0.270
IHD	25 (50.0)	29 (51.8)	0.850
Dyslipidemia	25 (50.0)	31 (55.4)	0.580
COPD	7 (14.0)	13 (23.2)	0.230
Clinical history: n (%)			
Asymptomatic	19 (38.0)	20 (35.7)	0.970
TIA	21 (42.0)	20 (35.7)	0.510
Stroke	10 (20.0)	16 (28.6)	0.310
Smoking	13 (26.0)	18 (32.1)	0.490
CCO	15 (30.0)	25 (44.6)	0.120
Peripheral vascular disease	22 (44.0)	26 (46.4)	0.800
Patients on antiplatelets	36 (72.0)	38 (67.9)	0.640
GFR <60 ml/minutes	5 (10.0)	10 (17.9)	0.250
Location side: n (%)			
Left	22 (44.0)	30 (53.6)	0.330
Right	28 (56.0)	26 (46.4)	
Shunting: n (%)	15 (30.0)	25 (44.6)	0.170

Note. SD: Standard deviation; CCO: Contralateral carotid occlusion; COPD: Chronic obstructive pulmonary disease; DM: Diabetes mellitus; GFR: Glomerular filtration rate; HTN: Hypertension; IHD: Ischemic heart disease; & TIA: Transient ischemic attacks

Table 2. Postoperative complications in studied groups

Variables	PRC (n=50)	PAC (n=56)	p
Stroke	3 (6.0)	2 (3.6)	0.740
Infection	-	2 (3.6)	0.520
Hematoma	1 (2.0)	1 (1.8)	0.940
Pseudoaneurysm	-	2 (3.6)	0.520
Cranial nerve injury	1 (2.0)	1 (1.8)	0.940
Postoperative cardiac events	1 (2.0)	1 (1.8)	0.940

Table 3. Restenosis rate in studied groups

Variables	PRC (n=50)	PAC (n=56)	p
At three months: n (%)			
30.0-50.0%	1 (2.1)	-	
50.0-70.0%	-	-	0.880
70.0-90.0%	-	-	
Total	1 (2.1)	-	0.960
At one year: n (%)			
30.0-50.0%	2 (4.3)	-	
50.0-70.0%	2 (4.3)	1 (1.9)	0.830
70.0-90.0%	3 (6.4)	-	
Total	7 (14.9)	1 (1.9)	0.046

Postoperatively, no significant differences were found between the studied groups regarding rates of stroke (6.0% versus 3.6%, p=0.740), infection (0.0% versus 3.6%, p=0.520), hematoma (2.0% versus 1.8%, p=0.940), pseudoaneurysm (0.0% versus 3.6%, p=0.520), cranial nerve injury (2.0% versus 1.8%, p=0.940), and cardiac events (2.0% versus 1.8%, p=0.940) (**Table 2**).

At three months, three patients in PRC group and four in PAC group were lost to follow up. No significant differences were found between the studied groups regarding rate of restenosis at three months (2.1% versus 0.0%, p=0.960). At one year, patients in PRC group experienced significantly higher rate of restenosis (14.9% versus 1.9%, p=0.046). None of the studied patients died (**Table 3**).

DISCUSSION & CONCLUSIONS

The present study sought to retrospectively compare the perioperative and 1-year outcome of patients submitted to PRC or PAC closure after CEA. Both techniques were comparable regarding perioperative complications and three months restenosis rate. But, at one year follow up, patients in PRC group experienced significantly higher rate of restenosis.

Our findings are in line with the conclusions in [9] randomized study who reported that at two years of follow up, PAC was associated with significantly lower restenosis rate without affecting other clinical outcomes including periprocedural stroke and death, immediate reoperation, and risk of ipsilateral stroke. Similar findings were documented by the retrospective study in [10] on 110 and 103 patients submitted to PRC and PAC, respectively. Likewise, the study of in [11] on CEA patients submitted to PRC (n=232) or PAC (n=511) found that PRC had significantly higher restenosis rate at one year. Using bovine PAC was also associated with lower restenosis rate at a mean follow duration of 26.1±19.3 months, as shown in [12]. Of note, the recent Swedish registry-based study in [13] concluded that PRC is associated with higher risk of ipsilateral stroke <30 days with no difference between groups after the perioperative phase.

In contrast, one large study of 1,737 CEA patients, half of them had PAC and others had PRC and eversion closure found no significant differences between the studied groups regarding postoperative complications or stroke, mortality, or restenosis rates [14]. Again, the retrospective study in [15] identified no differences between PRC and PAC in respect to stroke, mortality, restenosis, and other complications at one year. Other more recent studies reported concordant results including the retrospective studies in [16-21].

The contradictory conclusions of different studies are probably attributed to the different selection criteria of included patients, technical specifications, and different study designs. A multinational randomized study with unified technique and selection criteria is strongly advocated to resolve this issue.

Conclusively, the present study suggests that CEA combined with patch angioplasty may be associated with lower restenosis rate. It is a straightforward surgical procedure with short operative times and hospital stays.

Author contributions: All authors have sufficiently contributed to the study and agreed with the results and conclusions.

Funding: No funding source is reported for this study.

Acknowledgments: The authors would like to thank the patients' families for their participation in this study.

Ethical statement: The authors stated that the study was approved by AL-Azhar University local Ethics Committee, Faculty of Medicine (for girls) on date here (Approval code: code here). All procedures were in accordance with the Helsinki Declaration. Written informed consent was completed by each child's parents.

Declaration of interest: No conflict of interest is declared by the authors.

Data sharing statement: Data supporting the findings and conclusions are available upon request from the corresponding author.

REFERENCES

1. Hassani S, Fisher M. Management of atherosclerotic carotid artery disease: A brief overview and update. Am J Med. 2022;135(4):430-4. https://doi.org/10.1016/j.amjmed.2021.09.027 PMid:34732352
2. Sun J, Yuan C, Hatsukami TS. Stroke prevention with extracranial carotid artery disease. Curr Cardiol Rep. 2021;23(11):161. https://doi.org/10.1007/s11886-021-01593-1 PMid:34599416
3. Uno M, Takai H, Yagi K, Matsubara S. Surgical technique for carotid endarterectomy: Current methods and problems. Neurol Med Chir (Tokyo). 2020;60(9):419-28. https://doi.org/10.2176/nmc.ra.2020-0111 PMid:32801277 PMCid:PMC7490601
4. Aburahma AF. Primary versus patching versus eversion as carotid endarterectomy closure. J Cardiovasc Surg (Torino). 2023;64(2):174-83. https://doi.org/10.23736/S0021-9509.23.12618-8 PMid:36745480
5. Huizing E, Vos CG, van den Akker PJ, Schreve MA, de Borst GJ, Unlu C. A systematic review of patch angioplasty versus primary closure for carotid endarterectomy. J Vasc Surg. 2019;69(6):1962-74.e4. https://doi.org/10.1016/j.jvs.2018.10.096 PMid:30792057
6. AbuRahma AF, Clement Darling 3rd R. Literature review of primary versus patching versus eversion as carotid endarterectomy closure. J Vasc Surg. 2021;74(2):666-75. https://doi.org/10.1016/j.jvs.2021.02.051 PMid:33862187

7. Marsman MS, Wetterslev J, Jahrome AK, et al. Carotid endarterectomy with patch angioplasty versus primary closure in patients with symptomatic and significant stenosis: A systematic review with meta-analyses and trial sequential analysis of randomized clinical trials. Syst Rev. 2021;10(1):139. https://doi.org/10.1186/s13643-021-01692-8 PMid:33957978 PMCid:PMC8103619
8. Orrapin S, Benyakorn T, Siribumrungwong B, Rerkasem K. Patch angioplasty versus primary closure for carotid endarterectomy. Cochrane Database Syst Rev. 2022;8(8):CD000160. https://doi.org/10.1002/14651858.CD000160.pub4 PMid:35920689 PMCid:PMC9347312
9. Malas M, Glebova NO, Hughes SE, et al. Effect of patching on reducing restenosis in the carotid revascularization endarterectomy versus stenting trial. Stroke. 2015;46(3):757-61. https://doi.org/10.1161/STROKEAHA.114.007634 PMid:25613307 PMCid:PMC4586019
10. Maertens V, Maertens H, Kint M, Coucke C, Blomme Y. Complication rate after carotid endarterectomy comparing patch angioplasty and primary closure. Ann Vasc Surg. 2016;30:248-52. https://doi.org/10.1016/j.avsg.2015.07.045 PMid:26541968
11. Cheng SF, Richards T, Gregson J, et al. Long term restenosis rate after carotid endarterectomy: Comparison of three surgical techniques and intra-operative shunt use. Eur J Vasc Endovasc Surg. 2021;62(4):513-21. https://doi.org/10.1016/j.ejvs.2021.06.028 PMid:34452836
12. Becit N, Sevil FC, Tort M, Adali F. Outcomes of arteriotomy closure technique for carotid endarterectomy: Bovine pericardial patch closure versus primary closure. Braz J Cardiovasc Surg. 2022;37(6):37-6. https://doi.org/10.21470/1678-9741-2020-0716 PMid:35675495 PMCid:PMC9713661
13. Jonsson M, Hammar K, Lindberg M, et al. Nationwide outcome analysis of primary carotid endarterectomy in symptomatic patients depending on closure technique and patch type. Eur J Vasc Endovasc Surg. 2023;65(4):467-73. https://doi.org/10.1016/j.ejvs.2022.12.033 PMid:36603661
14. Avgerinos ED, Chaer RA, Naddaf A, El-Shazly OM, Marone L, Makaroun MS. Primary closure after carotid endarterectomy is not inferior to other closure techniques. J Vasc Surg. 2016;64(3):678-83.e1. https://doi.org/10.1016/j.jvs.2016.03.415 PMid:27189766
15. Huizing E, Vos CG, Hulsebos RG, van den Akker PJ, Borst GJ, Unlu C. Patch angioplasty or primary closure following carotid endarterectomy for symptomatic carotid artery stenosis. Surg J (NY). 2018;4(2):e96-101. https://doi.org/10.1055/s-0038-1655757 PMid:29915809 PMCid:PMC6003887
16. Chung B-H, Heo S-H, Park Y-J, Kim Y-W, Woo S-Y, Kim D-I. Comparative analysis using propensity score matching analysis: Primary closure versus patch angioplasty during carotid endarterectomy. Ann Vasc Surg. 2020;62:166-72. https://doi.org/10.1016/j.avsg.2018.11.011 PMid:30763710
17. Nana P, Spanos K, Piffaretti G, et al. Long-term durability and safety of carotid endarterectomy closure techniques. World J Surg. 2020;44(10):3545-54. https://doi.org/10.1007/s00268-020-05604-0 PMid:32462218
18. Liu D, Li ZL, Wang M, et al. Comparative analysis of patch angioplasty versus selective primary closure during carotid endarterectomy performed at a single vascular center in China. Ann Vasc Surg. 2021;73:344-50. https://doi.org/10.1016/j.avsg.2020.11.036 PMid:33383139
19. Zagzoog N, Elgheriani A, Attar A, et al. Comprehensive comparison of carotid endarterectomy primary closure and patch angioplasty: A single-institution experience. Surg Neurol Int. 2022;13:1. https://doi.org/10.25259/SNI_1013_2021 PMid:35127201 PMCid:PMC8813614
20. Qumsiyeh Y, O'Banion LA, Dirks R, Ali A, Daneshvar M, Siada S. Primary arterial closure after carotid endarterectomy is a safe and expeditious technique in appropriately selected patients. Am J Surg. 2022;224(6):1438-41. https://doi.org/10.1016/j.amjsurg.2022.10.009 PMid:36241481
21. Wu S, Wang H, Guo J, et al. Comparison between conventional and patch carotid endarterectomy: A single-center retrospective study. World Neurosurg. 2024;184:e340-5. https://doi.org/10.1016/j.wneu.2024.01.127 PMid:38307201