Complication Rate after Carotid Endarterectomy Comparing Patch Angioplasty and Primary Closure

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Background: Carotid endarterectomy (CEA) reduces the risk for stroke in patients with internal carotid artery stenosis. The optimal surgical technique remains subject of debate. Literature suggests patch angioplasty reduces complication risk. However, primary closure shortens cross-clamp times and eliminates graft-specific complications. This study aimed to assess complication rate after CEA with selective patching.
Methods: A total of 213 consecutive CEAs over a 3-year period from January 5th, 2011 to December 19th, 2013 were retrospectively analyzed. Postoperative complications were evaluated within 1 month after surgery.
Results: Primary closure was used in 110 operations and patch angioplasty in 103 procedures. Primary closure was performed when the carotid artery had a diameter above 5 mm, when there was a high carotid bifurcation, and when the contralateral carotid artery was occluded. After primary closure, we found 4 (3.6%) complications: 2 (1.8%) bleeding and 2 (1.8%) cranial nerve damage. After patch angioplasty 5 (4.9%) complications occurred: 1 (1.0%) bleeding, 2 (1.9%) cranial nerve damage, 1 (1.0%) cerebrovascular event, and 1 (1.0%) cerebral hyperperfusion resulting in mortality. There was no higher complication risk after primary closure ($P = 0.68$). Clamp time was significantly longer when using patch angioplasty ($P < 0.001$).
Conclusions: Primary closure appears to be an equivalent closure technique compared with patch angioplasty when used in selected patients.

INTRODUCTION

Carotid endarterectomy (CEA) reduces the risk of cerebrovascular and long-term ischemic events in patients with symptomatic or high-grade (>80%) asymptomatic internal carotid artery stenosis.[1–3] The risk for adverse events caused by this intervention depends on achieving a smooth endarterectomised surface with gradually tapered distal end point and precise closure of the artery. An accurate closure technique contributes to optimal hemodynamics of the vessel; however, the ideal surgical closure technique during CEA remains a subject of debate.

The use of patch angioplasty has been suggested to improve hemodynamic flow in the artery by increasing the carotid artery diameter.[4–6] However, this positive influence of patch closure on the hemodynamic profile has been questioned. Harrison et al.[7] found no favorable flow dynamics after patching, since incorporation of a patch increases areas of low wall shear stress and high oscillatory shear index at the bifurcation. The clinical impact of these hemodynamic changes on patient's outcome has

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been studied. Some studies indicate that carotid patch angioplasty reduces the risk of immediate postoperative complications, and significantly lowers vessel restenosis and occlusion rates.[8] However, patch angioplasty has also been associated with rare patch specific complications, such as patch rupture, false aneurysm formation, and thromboembolism stemming from the dilated, aneurysmal carotid bifurcation.[9,10] Especially saphenous vein patch angioplasty has been shown to be prone to aneurysmal dilatation.[11–13]

Primary closure has the advantage of eliminating graft-specific complications and reducing cross-clamp times in comparison with patch angioplasty.[9,10,14] In addition, large published series of CEA showed excellent results when primary closure was used.[15,16] These considerations have led many surgeons to recommend selective use of patch closure.

This study aimed to examine 30-day morbidity and mortality rates after CEA and to compare these results according to closure technique: primary closure versus patch angioplasty. Additional follow-up using yearly duplex ultrasound during a 5-year period is ongoing, to allow assessment of late complications and long-term patency of the CEA.

MATERIAL AND METHODS

Study Population

A total of 213 consecutive CEA procedures (115 left and 98 right) carried out at Sint-Lucas Hospital, Ghent, Belgium, were analyzed in this retrospective study. Data were collected over a period of 3 years from January 2011 to December 2013. No subjects were excluded. Overall 141 males and 72 females were included in this study with a mean age of 73 years (standard deviation [SD], 8.57; range, 53–95).

Individual patient characteristics were registered, including preoperative ipsilateral and contralateral stenosis on carotid color duplex ultrasound scans and angiographic studies,[17] baseline blood cholesterol and triglyceride levels. Preoperative risk factors were listed, including hypertension, diabetes mellitus, coronary artery disease, smoking status, and preoperative use of aspirin and/or anticoagulants.[18] Indications for surgery were asymptomatic high-grade carotid stenosis (>80%) and symptomatic carotid artery stenosis, categorized into transient ischemic attack, cerebrovascular attack, and amaurosis fugax. Thirty-day morbidity and mortality data were registered.

Procedure and Materials

All CEA procedures were performed under general anesthesia with administration of systemic heparin. There was no shunting technique used.[19] The decision to perform patch angioplasty or primary closure was made by the primary operator during surgery, based on patient characteristics and experience of the surgeon. Primary closure was performed when the carotid artery had a diameter above 5 mm (measured during surgery), when there was a high carotid bifurcation, and when the contralateral carotid artery was occluded.

Primary closure was performed using 6-0 polypropylene suture material (Prolene; Ethicon, Inc, Somerville, NJ). For patch closure, a collagen-coated knitted polyester patch 6 × 75 mm (Hemacarotid Knitted Ultrathin Patch; Maquet Getinge Group, Rastatt, Germany) was tapered to the appropriate size to reconstruct the shape of the carotid artery. The patch was sewn into place with the same 6-0 Prolene suture material.

To obtain hemostasis, an absorbable hemostat and digital pressure were applied before skin closure (Surgicel® Fibrillar™ Absorbable Hemostat; Ethicon, Inc.). Protamine was given at the end of each procedure. Postoperative care included application of closed suction drainage and aspirin therapy. If patients were not under aspirin therapy, aspirin was started at least 24 hours before surgery (aspirin 80 mg daily). The patients were admitted to the intensive care unit or recovery postoperatively to monitor heart rate and blood pressure for at least 24 hours. All procedures were carried out by 2 vascular surgeons, both using the same techniques and decision-making criteria to perform primary or patch closure.

Statistical Analysis

Patients were grouped retrospectively according to primary closure or patch closure during the CEA procedure. Cross-clamp time was perioperatively recorded. Postoperative bleeding, infection, cranial nerve injuries, cerebrovascular events, cerebral hyperperfusion, and mortality were evaluated within 1 month after surgery.

For statistical analysis SPSS 22.0 (Statistical Package for the Social Sciences, IBM Company) was used. The values for the different groups deviated significantly from the Gaussian distribution ($P < 0.05$); therefore, nonparametric tests were used for all statistical analyses. Mann–Whitney U test was used to compare both groups (primary closure versus patch angioplasty).