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Carotid Endarterectomy Using The Eversion Method: Technique And Advantages

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Abstract

The role of carotid endarterectomy (CEA) for the treatment of atherosclerotic carotid bifurcation
disease is now well established (1,2). The conventional CEA involves the use of a longitudinal arteriotomy, plaque extraction, and
closure of the arteriotomy with or without a patch. The use of a saphenous vein patch requires a second incision, most frequently in
the problematic groin (3). The use of a prosthetic patch introduces the well-documented complications of a foreign body and
increases bleeding at the needle hole sites, particularly so for polytetrafluoroethylene (PTFE) (4). Even with patching, suturing of the
distal internal carotid artery (ICA) may cause stenosis in this segment. The use

of the eversion technique avoids such complications, and eliminates the need for a patch.
The concept of eversion for CEA was first introduced by DeBakey and colleges in 1959 (5). The common carotid artery (CCA) was severed distally followed by eversion of both the ICA and the external carotid artery (ECA). The intervening arterial segment between the ICA and ECA prevented adequate eversion of the ICA thus making management of the plaque endpoint almost impossible.
Consequently, this technique remained relatively unpopular.
In 1989, Kasprazak and Raithel described a modification of the original eversion technique involving oblique transection of the ICA at the carotid bulb (6).

This technique allowed for excellent visualization of the endpoint, with little chance of stenosis of the ICA. Since then, several favourable reports have emerged, particularly from Europe (7,8) and America (9,10). Since 1995 we have utilised such a technique in 23 cases of CEA. We describe the technique herein.

INTRODUCTION

The role of carotid endarterectomy (CEA) for the treatment of atherosclerotic carotid bifurcation disease is now well established (1,2). The conventional CEA involves the use of a longitudinal arteriotomy, plaque extraction, and closure of the arteriotomy with or without a patch. The use of a saphenous vein patch requires a second incision, most frequently in the problematic groin (3). The use of a prosthetic patch introduces the well-documented complications of a foreign body and increases bleeding at the needle hole sites, particularly so for polytetrafluoroethylene (PTFE) (4). Even with patching, suturing of the distal internal carotid artery (ICA) may cause stenosis in this segment. The use of the eversion technique avoids such complications, and eliminates the need for a patch.

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OPERATIVE TECHNIQUE

The patient is placed in a supine position with the neck turned to the opposite side and extended. A cervical block is performed involving the rami of C2 to C4 (11). Since the patient is awake, neurologic function is monitored by assessing the level consciousness and the patient's motor function on the contralateral side.

A 4-5 cm incision is made along the anterior border of the sternocleidomastoid, equidistant from the mastoid and the sternoclavicular joint, extending caudal or cephalad depending on the site of the bulb. The platysma muscle and intervening connective tissue is incised using electrocautery. The sternocleidomastoid muscle and the internal jugular vein are retracted laterally to expose the carotid artery. The ICA is dissected circumferentially beyond the level of the plaque. The junction between normal and diseased vessel is identified by noting the yellow incompressible wall of the atheromatous vessel, versus the blue compressible disease free distal artery. After clamping, the ICA is transected obliquely at the level of the bulb and full thickness circumferential mobilization of the ICA is performed to the level of the distal clamp. A 5-10 mm incision is made distally on the heel-end of the ICA. The plane for endarterectomy is developed circumferentially.

Figure 1

Figure 1. Incision into the junction of the common and internal carotid arteries.

Figure 2

Figure 2. Opening common carotid artery using a Pott's Scissor

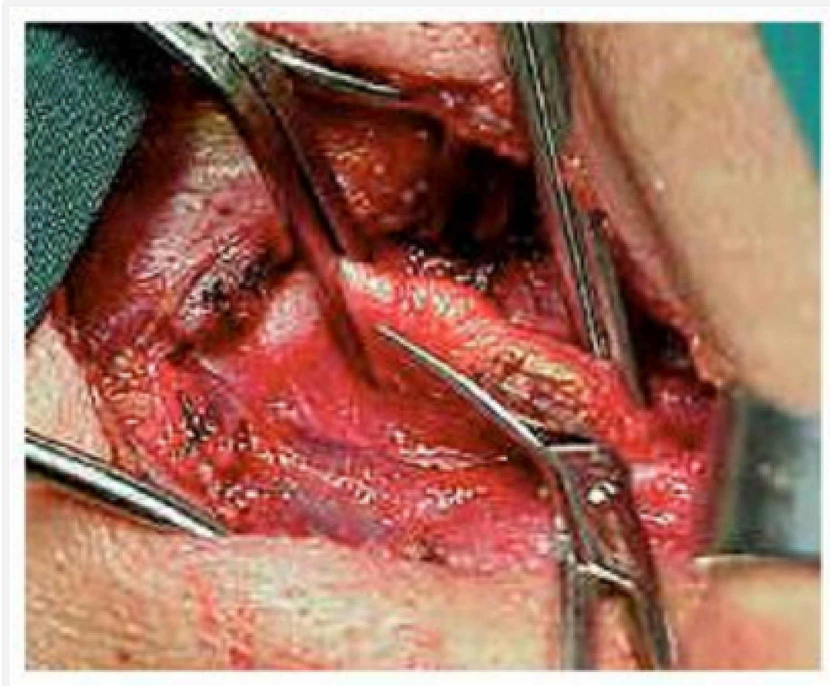


Figure 3

Figure 3. Divided internal and common carotid arteries.

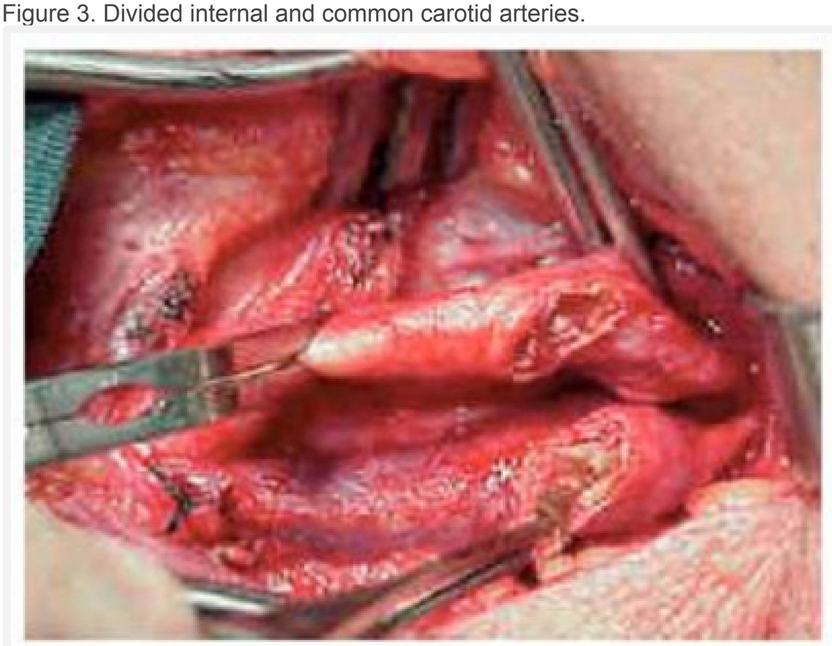


Figure 4

Figure 4. Beginning of carotid endarterectomy

DeBakey forceps are used to grasp the plaque and the vessel wall, the latter being gently peeled back and thus everted. Care must be taken not to tug at the plaque itself, which can lead to premature plaque fracture. Near the end point, the plaque is pinched and removed from the vessel. The end point is then inspected for semi-adherent fibres that are picked out with a ring forceps. Such fibres are easily recognized by irrigating with heparinized saline.

Figure 5

Figure 5. Carotid Endarterectomy in progress.

The plaque in the ECA and CCA is now dealt with in the conventional way- the plaque is elevated and transected. The plaque on the ECA is removed by traction and partial eversion. The plaque on the CCA is then extracted by eversion and transection of the plaque flush with the everted edge. As with the ICA, the inner lumen is irrigated and inspected for loose debris.

Figure 6

Figure 6. Near completion of carotid endarterectomy (CEA) with pinching of plaque at end of CEA.

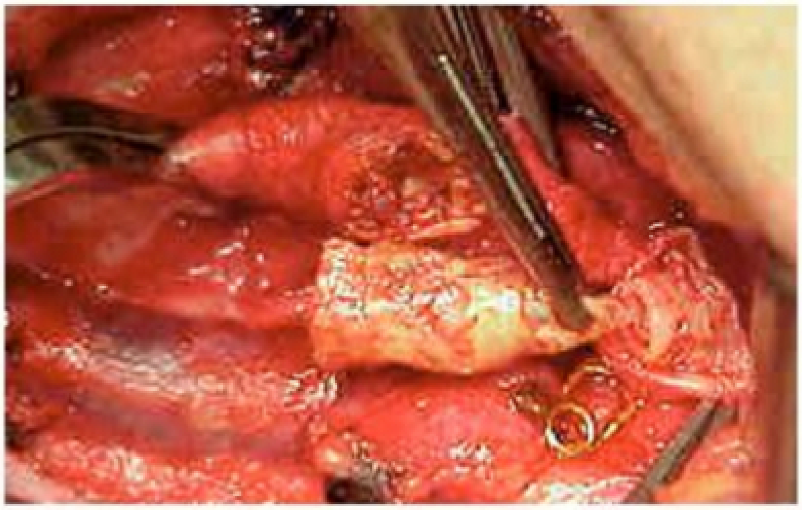


Figure 7

Figure 7. Plaque completely removed from the internal carotid and 'peeled back' vessel shown.

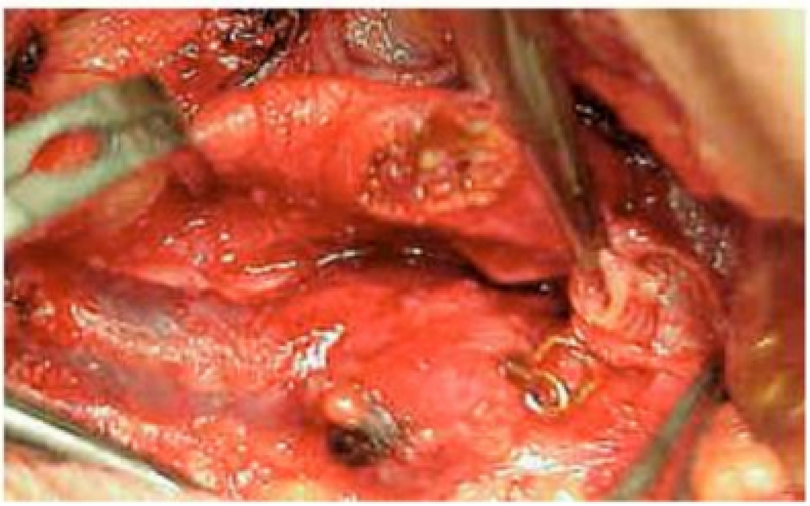


Figure 8

Figure 8. Clean vessel now ready for anastomosis.

The ICA and CCA are now re-anastomosed using 6/0 polypropylene suture in a continuous fashion. Near closure, the clamps are temporarily released thereby “flashing” the vessel of loose debris. On completion of the anastomosis, the ECA is opened to allow debris from the CCA to enter this system rather than the ICA system. Intraoperative Doppler assessment is performed to ensure patency.

Figure 9

Figure 9. Removed plaque shown next to internal carotid artery.

Figure 10

Figure 10. Internal carotid vessel being fashioned to match common carotid and thereby reducing the chances of stenosis.

Figure 11

Figure 11. Vessels now ready for anastomosis

Figure 12

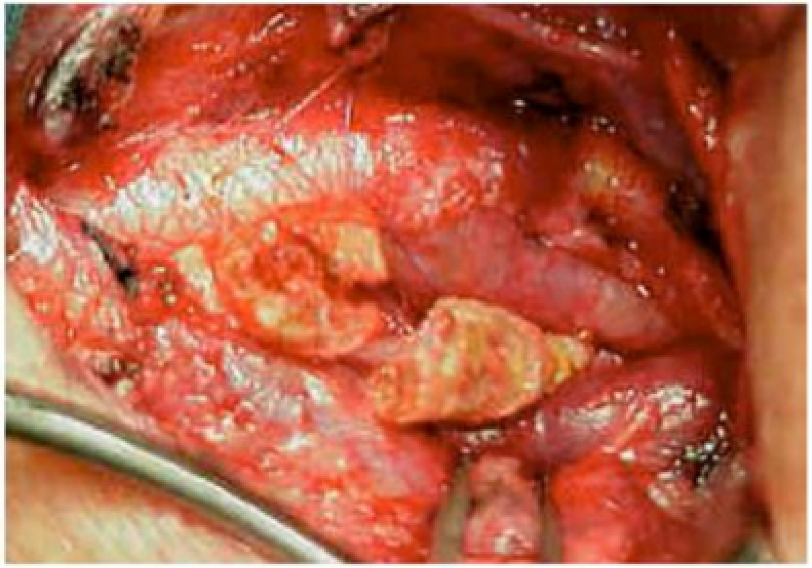
Figure 12. Backwall of anastomosis completed.

Figure 13

Figure 13. Completed anastomosis.

Figure 14

Figure 14. Removed plaques shown adjacent to common and internal carotid arteries.



SHUNTING

It is a firmly held misconception that shunting is impossible using the eversion technique. We have used the Javid Shunt successfully on several occasions. After transection of the ICA, the shunt can be placed distally either instantaneously if the end point is visualized, or after endarterectomy if the end point is not visualized. The shunt is placed proximally after the 1-cm incision is placed caudally in the CCA. Once flow is established, endarterectomy proceeds in the same fashion as described before. The shunt is removed near completion of the vascular anastomosis.

DISCUSSION

Until recently, the routine technical method of performing CEA was considered to involve a longitudinal arteriotomy that extends from the ICA to the CCA with patch closure. This technique has stood the test of time, having fulfilled the 2 prerequisites for successful CEA: Firstly, plaque extraction should leave the vessel lumen void of intimal flaps and retained debris especially in the distal segment. Equally important, closure of the arteriotomy must be performed without stenosis of the ICA (12). The use of the eversion technique also fulfils these criteria without the use of an autogenous or synthetic patch and their accompanying complications. In fact, eversion CEA has several advantages over the “conventional” technique. With patch closure, stenosis can still occur at the ends of the arteriotomy. With the eversion technique, the oblique incision in the carotid bulb is approximately 15 to 30 mm (4), making the diameter at anastomosis large. On closure, this allows the vessels to “patch each other” making the chance of stenosis negligible. This is reflected in several studies that demonstrate eversion CEA is associated with a lower occlusion and re-stenosis rate when compared to conventional CEA (13). It is also important to remember that with the conventional technique closure of the most distal portion of the ICA may be at the limit of the surgical field. With the eversion technique anastomosis is carried out at the center of the field with easy visualization of the vessel walls, making technical errors less likely to occur and facilitating quicker closure. It also avoids the uncomfortable retraction of the mandible and upper end of the incision – an essential manoeuvre for meticulous closure of the longitudinal arteriotomy. This is demonstrated in the study by Radak and colleges in which the clamp time for eversion CEA and conventional CEA was 13.5 and 19.9 minutes respectively (14). These factors may account for the data reported in the randomized controlled trial comparing the two techniques in which eversion was found to be associated with less perioperative neurologic complications and re-stenoses (15). After mobilization of the carotid artery it is not uncommon to have redundancy of the ICA segment. This can easily be dealt with by oblique resection of the redundant portion. This cannot be performed with such ease using the conventional technique. Furthermore, when kinks or coils are encountered, a similar simple modification of the eversion technique may be employed. Treatment of concomitant coils using the conventional technique can be complex and time-consuming (16). The incidence of nerve injury is less common with eversion versus non-eversion (17). This may be due to the fact that circumferential dissection of the ICA is performed only after transection from the bulb. This permits easy visualization of the posterior wall and facilitates dissection in the immediate periadventitial tissue. Shah and colleges demonstrated nerve injury in 1.08% of their conventional CEA versus only 0.26% for the eversion technique (17). The eversion technique is an elegant technique that facilitates complete removal of the atherosclerotic plaque without having to make a potentially stenosing arteriotomy in the distal ICA. The closure is technically easier and quicker and no patch is required. The overall complication rate, re-stenosis rate, and perioperative stroke/mortality are lower when compared to the conventional technique.

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