

Blowout of Carotid Venous Patch Angioplasty

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ABSTRACT

Two cases of vein patch blowout were observed five and seven days after carotid bifurcation endarterectomy with patch angioplasty. Both patients died in spite of emergency reoperation. One patient developed respiratory failure with subsequent fatal cardiac arrest seven days after reoperation; the other died of extensive hemispheric infarction on the fifth postoperative day. At reoperation both ruptures were found to be located in the middle of the patch whereas the suture lines were intact. Both patients were hypertensive. In the first case, an accessory saphenous vein retrieved from the calf had been the only venous material available for the patch, while the other patient had varicose veins in the contralateral leg. Pathology revealed central transmural tissue necrosis in one of the disrupted patches. A review of the literature regarding morphologic alterations of free vein grafts placed within the arterial circulation as well as hemodynamics in patched arterial segments may provide additional insight as to the inherent benefits and risks of vein patch angioplasty after carotid endarterectomy. When considering vein patch angioplasty, particular attention should be directed to the gross aspect of the vein to be used as well as to any antecedent history of phlebitis.

KEYWORDS : Carotid endarterectomy ; venous patch angioplasty ; arterial rupture ; angioplasty.

Carotid endarterectomy is the most common non-cardiac vascular procedure performed in our department. Blowout of a patch angioplasty after endarterectomy is an uncommon but severe complication of carotid artery surgery. Central disruption or blowout occurred in two of the 500 carotid artery patch angioplasties performed in our department between January 1980 and December 1987 (0.4%). These two cases form the basis of this report.

CASE REPORTS

Patient No. 1

A 62-year-old man was referred for high grade stenosis of the right internal carotid artery. Seven years prior to admission, the patient had sustained a limited cerebral infarction with permanent hemiparesis of the left leg. This patient had already undergone multiple vascular procedures (left carotid endarterectomy, bilateral venous femoropopliteal bypass). He was hypertensive and continued to smoke one pack of cigarettes per day. After an uneventful carotid endarterectomy, a vein patch was harvested from an accessory vein of the leg (the greater saphenous vein had already been used for the femoropopliteal bypasses).

On the fifth postoperative day, the patient suddenly developed dyspnea and swelling in the neck during sleep. He was immediately taken back to the operating room for surgical reexploration, but died of asphyxia due to tracheal compression. Autopsy revealed a median tear in the vein patch and a huge fresh hematoma in the neck.

Patient No. 2

A 68-year-old woman underwent left carotid endarterectomy for recurrent cerebral ischemic attacks. One month before admission, she had complained of dizziness and had experienced four reversible episodes of right hemiparesis with dysphasia. This patient had been receiving enalapril for severe hypertension and oral glibenclamide for diabetes mellitus. Moderate varicose veins were present in her left leg. Preoperative cerebral computed tomography (CT) scan was normal. Arteriography showed a subocclusive stenosis of the left carotid artery. Under general anesthesia, the patient underwent an uneventful endarterectomy with an inlay shunt, completed by patch angioplasty (5 cm segment of the greater saphenous vein retrieved from the right ankle).

Her immediate postoperative course was uncomplicated until the seventh postoperative day, when she abruptly hemorrhaged through the drain orifice upon awakening. She was immediately returned to the operating room in deep hypovolemic shock. Upon reexposure of the left carotid bifurcation, a 3 cm tear was found in the middle of

the patch whereas the suture lines had remained intact. The bleeding was initially controlled by digital compression, and subsequently by a balloon catheter placed in the common and internal carotid arteries. The vein patch was excised and a polytetrafluoroethylene (PTFE) patch was inserted. Total clamping time was 30 minutes.

The patient never regained consciousness. A CT scan 48 hours later showed an extensive left hemispheric infarction. She died five days after reoperation.

DISCUSSION

Disruption of a vein carotid patch is a serious complication which has been reported very rarely. Neurologic morbidity is high (27% of the reported cases), and outcome can be fatal, as illustrated by our two patients. Nevertheless, vein patch angioplasty remains a valuable procedure in carotid artery surgery.

Sundt [1], as others [2-8] advocate wide use of enlargement vein patch (up to 90% of their series). When a long longitudinal arteriotomy is used to gain exposure of disease-free carotid lumen by passing over the distal tongue of the plaque, patch graft angioplasty seems to be the safest way to close the arteriotomy without creating stenosis. The venous endothelium has been reported to enhance reendothelialization of the denuded media and to avoid intimal fibroplasia [5,9-11]. Patch angioplasty restores normal contour to the carotid bulb with minimal flow disturbances [2,4,7,8,12]. In a series of 250 carotid endarterectomies reported by Ban-dyk and associates [13], nine of the 10 intraoperative revisions for flow abnormalities (4% of all endarterectomized arteries) had undergone primary closure of their arteriotomy. For these and other authors [2,3,6,9,10,12], vein patching is associated with superior results and patency rates after endarterectomy, offering protection against early thrombosis and late recurrent stenosis. The benefits of vein patch angioplasty seem to be more striking in women [9].

On the other hand, for Curley and colleagues [14], the incidence of recurrent stenosis was similar after primary closure or patch enlargement. Clagett and coworkers [15] did not achieve superior results with vein patch angioplasty. In fact these authors found that vein patch angioplasty was associated with a higher incidence of early recurrence and increased duration of operation. The authors [15] recommended vein patch angioplasty only for selected patients at high risk for thrombosis: arteriotomy extending distally on the internal carotid artery for 3 cm or more, diameter of internal carotid artery less than 5 mm, and tortuous or kinking artery.

In their series of 67 vein patch angioplasties, Eikelboom and associates [16] described one case (1.4%) of patch rupture occurring on the second postoperative day in a hypertensive patient. Necrosis was observed in the central part of the patch. This patient sustained a reversible ischemic neurologic deficit after emergency reoperation. The authors nevertheless maintain a policy of patch closure in all women and in those men who have very small (the exact size was not stated) carotid arteries [9]. Three cases of patch disruption occurred in the series of 434 (0.7%) carotid endarterectomies reported by Hertzner and colleagues [discussion in 9,10]. One patient was found to have an unexplained rent in the center of the patch, while the remaining two patients had anastomotic disruption. Two of these blowout accidents were repaired successfully, whereas the other required carotid ligation because of infection at the disrupted suture line. Neither of these patients sustained permanent neurologic deficits. Archie [discussion in 9] described one case of patch blowout in a series of more than 400 procedures. The outcome of this patient, however, was not mentioned. Sundt and coworkers [1] reported three patients (0.8%) with brisk and major hemorrhage from a patched carotid artery. In two patients bleeding was from the suture line, and in the third it was due to vein patch rupture. All vessels were promptly repaired with success.

Venous patch rupture occurred within 72 hours of surgery in three patients of the series studied over a period of five years presented by Katz [6] (the incidence was not mentioned). Two of these patients experienced a permanent neurologic deficit. In each case, the thin walled vein patch ruptured centrally and operative suture lines were intact.

In all, we found 11 cases of patch blowout lesions in the literature. Rupture always occurred within the first postoperative week and was associated with severe hypertension in six cases. The estimated incidence was 0.25% to 1.4% of all patched carotid arteries. Necrosis associated with a rent in the center of the vein patch was found in seven of the patients, while four ruptures were due to anastomotic dehiscence.

Acute patch disruption should be distinguished from chronic false aneurysms after carotid endarterectomy and patching [11,17]. Kappey [17] reported one case of contained blowout of a vein carotid patch with a median tear

due to patch necrosis and dense periarterial fibrosis surrounding the laminated thrombus. Ligation of the carotid artery was performed four months later.

Factors that might reduce the incidence of patch rupture include meticulous technique, avoidance of excessive ballooning, enlargement at the endarterectomy site, selection of adequate venous material, and control of hypertension.

Technical considerations are of paramount importance in carotid surgery. The arteriotomy should be prolonged beyond the distal margin of the plaque, enabling visual control of the smooth feathering-off of the lesion at its end point on the posterior wall of the internal carotid artery [4,8,9,12-14,17-20]. Primary closure should be performed only for short endarterectomies in large arteries. For closure of an internal carotid artery of less than 4 mm in diameter, a small (3 to 4 mm) trimmed onlay patch, beveled at one end, is mandatory if compromise of the lumen is to be avoided [4,5,7,12,18,21,22]. Care must be exercised not to enlarge the vessel excessively.

Vein patches constitute a partial replacement of the arterial wall, and as such, there is almost invariably some enlargement of the lumen [21]. Hejhal and associates [20] observed 38% of aneurysmal dilatation of their vein patches on follow-up arteriograms. Moreover, turbulence and slowed flow change the distribution of energy in the dilated segment as evidenced by elevated lateral pressure (Bernoulli's principle [12]). It follows that a dilated patched arterial segment with a ballooning patch causes further expansion of the wall. In turn, this process continues by itself, as pressure and circumferential wall stress are directly proportional to the radius. This vicious circle can only be interrupted by occlusion or rupture of the involved dilated segment. It should be stressed that an overly large, doming patch has an intrinsic risk of rupture or expansion (aneurysm), since wall tension increases with the area of cross section after patch angioplasty.

The quality of the surrounding tissues and their resistance to expansion determine the final outcome: aneurysmal formation or free rupture [22,23]. It is evident that the freshly dissected and loose tissue layers of the neck resist an expanding patch poorly. This supports the policy of reconstruction of the carotid sheath as proposed by some investigators [8,22], providing a reinforcement of the suture line and preventing rupture.

For the patch, most authors [8-10,12,18] retrieve saphenous vein at the ankle, preserving the autologous vein for later coronary or limb revascularizations. In one of our patients, we had used a relatively thin, distensible portion of an accessory branch of the greater saphenous vein retrieved from the calf that we realized, retrospectively, was not suitable for carotid patching. In the other patient, although the vein patch had a normal appearance and strength, ultrastructural changes had likely occurred in its elastic layers, as the opposite leg veins were varicose. Saphenous vein in the groin may be thicker and less prone to blowout [6], but no surgeon likes to compromise the entire greater saphenous vein for such a short patch [9]. Patch material harvested from the external jugular vein is generally of insufficient strength to withstand arterial pressure. Fabric patches are not the first choice because of their thrombogenicity and their inherent risk of microembolization and higher postoperative occlusion rate [9], as well as the risk of infection [16,23]. We believe that the use of fabric patches in carotid reconstruction should be restricted to a minimum. This is in contrast to Derun and colleagues [10] and Schultz and coworkers [21] who advocate routine use of prosthetic patches.

There are several reports regarding the nature and significance of structural changes in grafted veins. Vein harvesting, preparation, and preservation are attended by obligate ischemia of the explanted tissue with subsequent cell swelling, edema, hemorrhage, focal necrosis and leukocyte infiltration [14,25-27]. Degeneration and necrosis of the media, associated with adventitial hemorrhage, are maximal in vein segments examined one week after grafting [9,15,25-27]. This coincides with the delay of rupture found in the reports of carotid artery patch blow out [1,9,10]. Progressive adventitial and medial fibrosis with minimal neovascularization develops after two weeks, altering the distensibility of the vein patch. This well-recognized phenomenon is considered to be a consequence of structural adaptation of the vein autograft being subjected to a high pressure regimen with high flow and shear stresses.

CONCLUSIONS

The catastrophic complication of patch rupture should not be considered as an argument against autologous vein patch angioplasty, which maintains a favorable benefit-to-risk ratio. This complication occurred in only 0.4% of our patched, endarterectomized carotid arteries. In our experience, autologous vein patch remains the most consistently successful graft material for closure of the carotid artery. It increases the safety and durability of carotid endarterectomy by enhancing rapid reendothelialization of the endarterectomy bed and preventing restenosis. Other arguments in favor of selective vein patching are decreased risk of early thrombosis and closure

without consequent narrowing of the lumen. Factors which have been implicated in the blowout of vein patches are hypertensive bouts and poor quality of vein. Structural properties of the vein patch, particularly its elasticity and rigidity, should be evaluated for their capacity to resist high arterial pressure regimens.

These two reported cases lead us to suggest the use of fabric patches only when no appropriate vein is available and to obtain rigorous control of hypertensive bouts, as necessary.

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