

◆ CASE REPORT

Endovascular Repair of an Innominate Artery True Aneurysm

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Purpose: To describe endovascular repair of a large aneurysm of the innominate artery in a patient with episodes of transient cerebral ischemia.

Case Report: A 44-year-old man with a history of transient hemiparesis and aphasia demonstrated a large mass in the upper right hemithorax on chest radiography. Systolic brachial pressure in the right arm was 100 mm Hg versus 130 mm Hg in the left. Imaging disclosed a large 12-mm-diameter aneurysm involving the brachiocephalic trunk 1 cm above its origin and the first portion of the right subclavian artery, which was occluded after the dilated segment. The aneurysm was treated with a tapered endograft made from polyester graft attached to a Palmaz stent inserted via a carotid artery arteriotomy. The distal end of the graft was anastomosed to the common carotid artery. Completion angiography showed exclusion of the aneurysm, which has been confirmed by imaging at 21 months. After 2 years, the patient is free from neurological symptoms and has a strong carotid pulse; no arm claudication developed.

Conclusions: Endovascular correction of innominate artery aneurysms is feasible whenever there is an adequate proximal neck for attachment. In these cases, thoracotomy may be avoided.

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Key words: brachiocephalic trunk, stent-graft, Palmaz stent, subclavian artery, cerebral embolization

Aneurysms of the innominate artery are potential sources of emboli to the brain and require surgical exclusion.¹ Conventional surgical treatment had been bypass grafting via a thoracotomy with² or without³⁻⁵ atriolfemoral pump perfusion. Correction of traumatic innominate artery false aneurysms using a combined surgical and endovascular approach has been previously reported,⁶⁻⁸ but the case we present involves successful endovascular repair of a large true aneurysm of the innominate artery using the Parodi technique.⁹

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CASE REPORT

A 44-year-old man was admitted to the hospital for evaluation of cerebral ischemia following 2 transient episodes of hemiparesis and aphasia 11 months and 7 months prior, for which he had received antiplatelet drugs at a community hospital. A chest radiograph (Fig. 1) at this admission showed a large mass in the upper right hemithorax. No neurological deficits were present, nor did the patient complain of arm claudication. The right radial pulse was palpable but weaker than the left. Systolic brachial pressure in the right arm was 100 mm Hg, compared to 130 mm Hg in the left.

Computed tomography (CT) (Fig. 2) and angiography (Fig. 3) performed prior to admis-

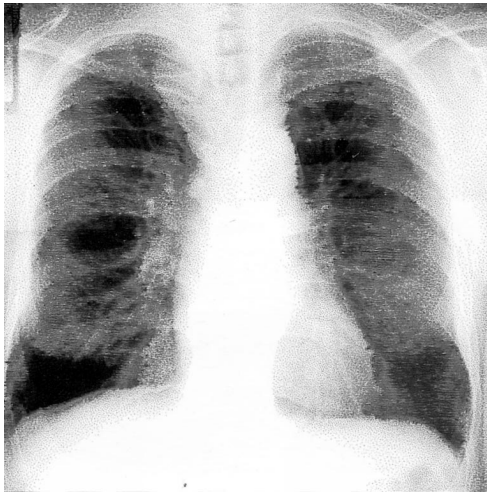


Figure 1 ♦ Chest radiograph showing a large mass in the upper right hemithorax.

sion disclosed a large 12-mm-diameter aneurysm involving the brachiocephalic trunk 1 cm above its take off from the aorta and the first portion of the right subclavian artery, which was occluded after the dilated segment. The right vertebral artery was also occluded, but the right common carotid artery (CCA) and the left carotid, subclavian, and vertebral arteries were normal. Mural thrombus was found inside the aneurysm, confirming the lesion as the most likely cause of the transient ischemic attacks.

After informed consent for an endograft procedure was obtained, the patient was taken to the surgical suite, where a 5-cm longitudinal incision in the neck was made under local anesthesia to expose the right CCA. After dissection, 10,000 units of heparin were administered intravenously, and the carotid was clamped for 3 minutes to test the efficiency of the collateral circulation; no signs or complaints of any neurological disturbances were elicited. The clamp was released while the stent-graft was prepared.

One limb of a 14- × 7-mm bifurcated knitted Dacron graft was transected at its origin and the opening closed with sutures to create a tapered graft. At the larger end of the graft, a P4014 Palmaz stent (Cordis Endovascular, Warren, NJ, USA) was affixed with 4 sutures. A 15- × 40-mm angioplasty balloon was in-

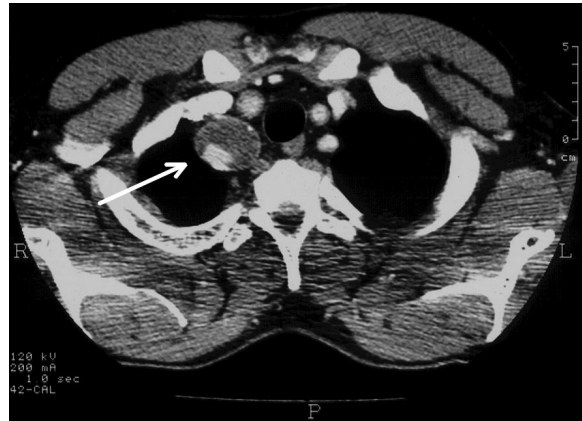


Figure 2 ♦ Preoperative CT scan showing mural thrombus (arrow) in the innominate artery aneurysm.

serted inside the stent-graft, and the entire device was loaded into a 20-F sheath.

When the device was ready for implantation, general anesthesia was induced, and an angiography catheter was delivered percutaneously through the left brachial artery to the



Figure 3 ♦ Preoperative aortic arch angiogram documenting the innominate artery aneurysm and occlusion of the brachiocephalic trunk 1 cm above its take off from the aorta. The right vertebral and right subclavian arteries are occluded, the latter after the dilated segment. The right and left common carotid arteries and left vertebral artery are patent.



Figure 4 ♦ CT scan 21 months after the procedure shows a patent stent-graft and shrinkage of the aneurysm sac.

aorta for contrast injection. The precise site of implantation at the origin of the innominate artery was marked with a needle inserted in the skin. The carotid artery was clamped distally and controlled proximally with a vascular loop. A transverse arteriotomy was made, through which the 20-F sheath was introduced for delivery of the stent-graft device under fluoroscopic guidance. The stent was positioned in the innominate artery 1 cm from the aortic arch. After withdrawal of the sheath, the balloon was inflated to expand the stent. Angiography by injection through the graft followed to confirm adequate positioning.

The narrowest (distal) end of the graft was cut transversely, and the arteriotomy was transformed into a complete transection of the carotid. Both the proximal carotid stump and the graft were sutured together to the distal carotid stump. After completion of the anastomosis, the circulation was restored, and an angiogram was obtained through the brachial catheter. The stent-graft appeared well positioned with no signs of leakage. Contrast-enhanced CT scanning 3 days after the procedure documented absence of contrast in the aneurysm sac. No neurological, ischemic, or local complication occurred, and the patient was discharged on the 7th postoperative day.

CT images obtained at 6, 10, and 21 months (Fig. 4) revealed a decrease in aneurysm size with no signs of endoleak. At the 24-month evaluation, the patient was asymptomatic. Carotid pulses were palpable, normal, and symmetrical. No arm claudication was report-

ed, and the brachial arterial pressures were unchanged from the preoperative levels.

DISCUSSION

True aneurysms of the innominate artery are rare. Bower et al.¹ found only 6 cases in a retrospective survey of the Mayo Clinic records over 40 years. The options for surgical treatment always require thoracotomy with bypass grafting to the carotid artery, either from the ascending aorta with ligation of the aneurysm neck or from the neck itself. In both options, pump perfusion from the atrium to the descending aorta or femoral artery may be necessary.

Endovascular stent-grafting for aneurysmal and traumatic lesions in the proximal aortic arch vessels has met with considerable success,^{6-8,10-14} affording a much less invasive treatment option. We adapted the Parodi technique for excluding abdominal aortic aneurysms to this innominate aneurysm and found it efficient and effective in the aortic arch territory. Our patient tolerated carotid clamping well, but if that had not been the case, a left-to-right carotid bypass could have been performed, allowing endovascular repair either using the technique described here or by simple endovascular exclusion of the aneurysm neck. Temporary occlusion of the vertebral artery can usually be tolerated if the contralateral vertebral is patent.

The patient had no symptoms referable to the right subclavian artery occlusion because it was distal to the aneurysm. Had the subclavian artery been patent then an axillary-axillary bypass graft might have been required before the endograft was placed. Alternatively, a carotid-subclavian graft could be performed at the same operative procedure.

At the time of the operation, we considered the possibility that back flow from the patent segment of the subclavian artery could perfuse the aneurysm. The goal at the initial treatment was to prevent further episodes of cerebral embolization, so endovascular occlusion of the subclavian artery at its origin was delayed until collateral circulation to the arm became more efficient. However, CT scans after a few months showed a decrease in the

size of the aneurysm, making the second procedure unnecessary.

REFERENCES

1. Bower TC, Pairolero PC, Hallet Jr JW, et al. Brachiocephalic aneurysm: the case for early recognition and repair. *Ann Vasc Surg.* 1991;5:125-132.
2. Thomas TV. Intrathoracic aneurysms of the innominate and subclavian arteries. *J Thorac Cardiovasc Surg.* 1972;63:461-471.
3. Brewster DC, Moncure AC, Darling C, et al. Innominate artery lesions: problems encountered and lessons learned. *J Vasc Surg.* 1985;2:99-112.
4. Schumacher PD, Wright CB. Management of arteriosclerotic aneurysm of the innominate artery. *Surgery.* 1979;85:489-495.
5. Ketonen P, Meurala P, Harjola T, et al. Management of arteriosclerotic aneurysms of the innominate and subclavian arteries. *Scand J Thorac Cardiovasc Surg.* 1983;17:129-133.
6. Reubben A, Merlo M, Verri A, et al. Combined surgical and endovascular treatment of a traumatic pseudoaneurysm of the brachiocephalic trunk with anatomical anomaly. *J Cardiovasc Surg.* 1997;38:173-176.
7. Chandler TA, Fishwick G, Bell PR. Endovascular repair of a traumatic innominate artery aneurysm. *Eur J Vasc Endovasc Surg.* 1999;18:80-82.
8. Axisa BM, Loftus IM, Fishwick G, et al. Endovascular repair of an innominate artery false aneurysm following blunt trauma. *J Endovasc Ther.* 2000;7:245-250.
9. Parodi JC, Palmaz JC, Barone HD. Transfemoral intraluminal graft implantation for abdominal aortic aneurysms. *Ann Vasc Surg.* 1991;5:491-499.
10. Meyer T, Merkel S, Lang W. Combined operative and endovascular treatment of a post-traumatic embolizing aneurysm of the subclavian artery. *J Endovasc Surg.* 1998;5:52-55.
11. Patel AV, Marin ML, Veith FJ, et al. Endovascular graft repair of penetrating subclavian artery injuries. *J Endovasc Surg.* 1996;3:392-388.
12. Sullivan TM, Bacharach JM, Perl J, et al. Endovascular management of unusual aneurysms of the axillary and subclavian arteries. *J Endovasc Surg.* 1996;3:389-395.
13. Simionato F, Righi C, Melissano G, et al. Stent-graft treatment of a common carotid artery pseudoaneurysm. *J Endovasc Ther.* 2000;7:136-140.
14. Malone A, Ingledew N, Cheshire N, et al. Endovascular repair of an iatrogenic left common carotid to innominate vein fistula. *Eur J Vasc Endovasc Surg.* 1999;18:532-533.