Treating a Carotid Artery Vein Patch Aneurysm Using the Viabahn Endoprosthesis

A look at this endovascular tool and a review of literature on carotid artery aneurysms.

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Carotid aneurysms of the extracranial carotid artery are rare and account for 0.4% to 1% of all aneurysms.[1-3] The various etiologies include atherosclerosis, pseudoaneurysms, and aneurysmal dilation from a previous carotid endarterectomy (CEA), traumatic lesions, and more rarely fibromuscular dysplasia, Takayasu's arteritis, neurofibromatosis, and Behçet disease.[4-7] Neurological symptoms are common, occurring in 14% to 70% of patients, with additional symptoms of cranial nerve compression in some patients.[1-3,8] Nonoperative treatment in various series is associated with significant stroke/death rates as high as 50% to 70%.[2,8] Traditional operative treatment of carotid ligation is associated with a high incidence of stroke and death. In the historic review of 106 extracranial carotid aneurysms, Winslow described an operative mortality rate of 30% associated with carotid ligation.[8] The high incidence of complications related to ligation was likely from extension of occlusion into the intracranial vessels in an era when vascular surgery was performed without anticoagulation. Reconstructive surgery is often difficult with a high incidence of cranial nerve injury and stroke.[1-3]

In this case report, we describe a patient with previous CEA and vein patch repair of the right internal carotid artery who had subsequent neck exploration and dissection for base-of-tongue cancer. He was additionally treated with radiation therapy. He presented to our department 7 years later with an enlarging right carotid artery aneurysm containing a large amount of thrombus. The patient was successfully treated with a Viabahn endoprosthesis (Gore & Associates, Flagstaff, AZ).

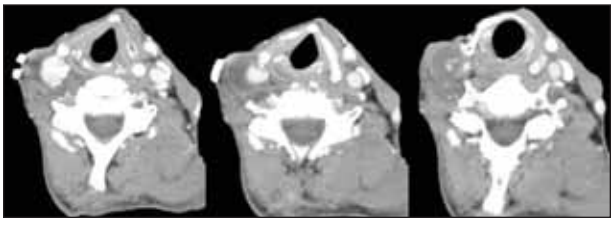

Figure 1. Pre-treatment CT scan demonstrating a large aneurysm extending from the right common carotid artery containing a large amount of thrombus.

CASE REPORT

A 63-year-old man presented with an uncomfortable pulsatile mass in his right neck. He had a right CEA with vein patch repair 10 years previously. He subsequently developed head and neck cancer requiring right neck dissection with glossectomy and radiation therapy of the right neck 7 years previously. Several months prior to presentation, the patient noted progressive enlargement of the pulsatile mass in the right neck. A CT scan demonstrated a large pseudoaneurysm arising from the level of the right common carotid artery and progressing to a patulent right common carotid artery patch. A large amount of irregular thrombus was present in the 2.5-cm pseudoaneurysm, with the normal right common carotid artery measuring approximately 6 mm (Figure 1). The institutional review board is not required for this type of case at our institution; however, detailed informed consent was obtained from the patient and family. The patient and our service believed the risks of endovascular repair were less than operative intervention.

The patient was treated with clopidogrel 75 mg/d and aspirin 325 mg/d for 2 weeks prior to the procedure.

Intravenous cefazolin (1 g) was administered immediately before the procedure. Anticoagulation was achieved with a bivalirudin weight-adjusted bolus and continuous drip. Complete angiographic evaluation of the arch and intracerebral circulation was performed (Figure 2). An 8-F Shuttle sheath (Cook Medical, Bloomington, IN) was placed over a 6.5-F, H1 select (Cook Medical), 125-cm catheter using the telescoping technique into the right common carotid artery to the level of the clavicle. The patient had previous intervention for his head and neck cancer, skeletonizing the external carotid artery with previous ligation of the superior thyroid, ascending pharyngeal, and lingual branches. A 125-cm, 5-F vertebral catheter (Cordis Corporation, a Johnson & Johnson company, Miami, FL) was placed in the internal maxillary and ascending trunk of the right external carotid artery, and both branches were embolized with 4-mm Nester coils (Cook Incorporated) protruding into the main right external carotid trunk (Figure 3A). A Tad II wire (Mallinckrodt Corporation, St. Louis, MO) was placed through the vertebral catheter after it was carefully placed to the level of the skull base.

Two overlapping Viabahn stent grafts, measuring 5 mm X 5 cm distally and 6 mm X 5 cm proximally, were placed over the Tad II wire, achieving 2 cm of seal zone in the internal carotid artery and 2 cm of seal zone in the common carotid artery with a total of 6.5 cm of stented artery. Using a second BMW wire (Guidant Corporation, St. Paul, MN), a 4.5-mm X 2-cm Sterling balloon (Boston Scientific Corporation, Natick, MA) and a 6-mm X 2-cm Sterling balloon were utilized to dilate the distal and proximal segments. Final angiography demonstrated complete aneurysm exclusion with excellent stent apposition to the arterial walls (Figure 3B). The aneurysm was no longer pulsatile, and the neurological examination yielded normal findings. Follow-up ultrasonography confirmed wide patency, with exclusion of the aneurysm with significant decrease in size to 2 cm.

DISCUSSION

CEA is the most common vascular surgery operation with excellent results that challenge the acceptance of carotid stenting. Patch closure repair significantly decreases the incidence of restenosis from 10% to 20% to only 1% to 3%.[9,10] CEA with vein patch repair benefits were clearly demonstrated in the Cleveland Clinic experience, but the lesser tensile strength of lower-leg saphenous vein was also noted. Aneurysmal dilation of the repair, however, can occur with both PTFE closure or vein patch closure and has been reported to occur in up to 9% of PTFE closures and 17% of saphenous vein patch repairs.[11,12] To avoid aneurysmal dilation with the deposition of thrombus, care must be taken to restrict the width of the patch to no more than 5 mm to 8 mm.

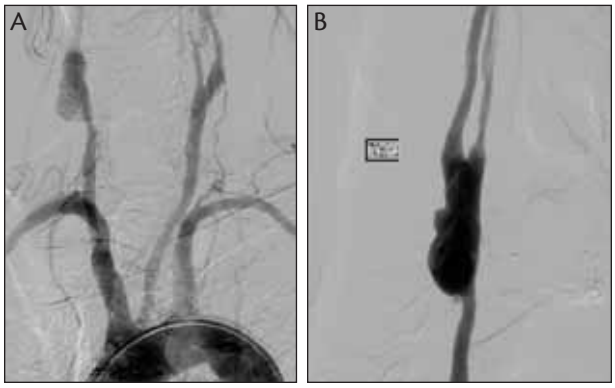

Figure 2. Pre-treatment angiogram in left anterior oblique (A) and right anterior oblique (B) projections.

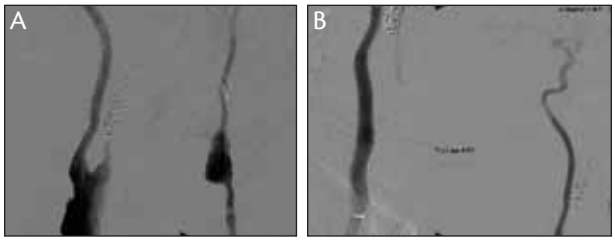

Figure 3. Post-coil embolization of external carotid artery (A). Final post-treatment angiogram after coil embolization of external carotid artery and Viabahn endoprosthesis across aneurysmal carotid segments (B).

The largest evaluation of carotid aneurysms has been by the Texas Heart Institute with additional large series submitted from the University of Michigan and Baylor University.[1-3] El-Sabrout et al found 38 pseudoaneurysms after previous carotid surgery and 29 atherosclerotic or traumatic aneurysms. The incidence of neurologic symptoms in the atherosclerotic aneurysms and pseudoaneurysms was between 30% and 50%, underscoring the likely natural history of aneurysmal dilation of the carotid artery. The Baylor University series by McCollum et al[13] identified 37 aneurysms with 15% presenting with neurologic symptoms. The University of Michigan experience cited a 50% stroke rate with nonoperative management.[2] The historic evaluation of carotid aneurysms by Winslow reported a 71% all-cause mortality with carotid aneurysm complications followed nonoperatively.[8]

The operative incidence of all stroke or death in various series ranged from 10% to 20% with a 5% to 20% incidence of cranial nerve palsy.[1-3,13] In an evaluation by Lumsden et al of 22 patients treated surgically between 1985 to 1994, the incidence of cranial nerve injury was 14%, and the major stroke/death rate was 14%.[14] The complications are related to the difficulty of exposing the carotid artery in an often hostile neck with an aneurysm that contains large amounts of thrombus and surrounding inflammatory changes.

In the setting of postcarotid endarterectomy restenosis, carotid artery stenting demonstrated 50% reduction in all complications compared to redo surgery.[15,16] The strategy of carotid artery stenting was largely adopted for carotid restenosis despite the fact that symptoms arising from restenosis are rare and as low as 2%.[17,18] In the setting of carotid aneurysms, both the natural history and operative risks are considerable, making endovascular repair attractive. Various forms of cerebral protection can be obtained endovascularly, and good results are seen in the literature with sporadic reports of endovascular management of carotid aneurysms.

Initial endovascular management of traumatic pseudoaneurysms depended on a narrow neck and included transcatheter carotid occlusion, placement of closed-cell stents with remodeling, closing the pseudoaneurysm, coil placement with bare-metal stents, and even balloon occlusion protection with thrombin injection again with a narrow neck.[19-22] Covered stents are, however, required for large-neck aneurysms. Initial cases were limited to "homemade" devices that invariably used balloon-expandable stents.[23] The use of balloon-expandable stents is limited to areas free from external compression or extensive motion. However, the commercially available Jostent (Abbott Vascular, Abbott Park, IL) was used successfully in several cases.[24,25] Polyethylene terephthalate-covered Wallgrafts (Boston Scientific Corporation) were then utilized successfully in several reports.[26,27] Several reports of Wallgraft restenosis in iliac arteries, superficial femoral arteries, and then carotid arteries have entered the literature.[28,29] The Viabahn endoprosthesis appears to have the best performance and was therefore chosen as the best option for repair.[30] The Viabahn stent graft has been successfully utilized by Powell et al from Dartmouth and by operators from Texas Heart.[31-33]

In this report, we repaired a 2.5-cm common carotid artery aneurysm with a large amount of irregular thrombus in a patient with a hostile neck from previous CEA, radical neck surgery, repeat neck dissection, and radiation therapy. We chose the Viabahn endoprosthesis secondary to its excellent results in other vascular beds susceptible to external forces. Additionally, there are case reports of Wallgraft endoprosthesis restenosis and migration. A recent report from Duke demonstrated 50% to 100% restenosis in three out of four patients.[28] We had the option of using filter wires with a double-wire technique versus meticulous technique with detailed understanding of the location of the thrombus and chose the latter in this scenario in which only after placement of covered stents postimplant dilatation was being performed.

CONCLUSION

In the setting of carotid artery aneurysms with a poor natural history prognosis consisting of stroke and death and difficult surgical treatment, endovascular stent grafting will likely emerge as the treatment of choice similar to this case report. Further studies are needed, however. ■

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1. El-Sabrout R, Cooley DA. Extracranial carotid artery aneurysms: Texas Heart Institute experience. J Vasc Surg. 2000;31:702-712.
2. Zwolak RM, Whitehouse WM, Knake JE, et al. Atherosclerotic extracranial carotid artery aneurysms. J Vasc Surg. 1984;3:415-422.
3. Painter TA, Hertzer NR, Beven EG, et al. Extracranial carotid aneurysms: report of six cases and review of the literature. J Vasc Surg.1985;2:312-318.
4. Smith BL, Munschauer CE, Diamond N, et al. Ruptured internal carotid aneurysm resulting from neurofibromatosis: treatment with intraluminal stent graft. J Vasc Surg. 2000;32:824-828.
5. Bouarhroum A, Sedki N, Bouziane Z, et al. Extracranial carotid aneurysm in Behcet disease: Report of two new cases. J Vasc Surg. 2006;43:627-630.
6. Tabata M, Kitagawa T, SaitoT, et al. Extracranial carotid aneurysm in Takayasu's arteritis. J Vasc Surg. 2001;34:739-742.
7. Miyauchi M, Shionoya S. Aneurysm of the extracranial internal carotid artery caused by fibromuscular dysplasia. Eur J Vasc Surg. 1991;5:587-591.
8. Winslow N. Extracranial aneurysms of the internal carotid artery. Arch Surg. 1926;13:689-729.
9. Hertzer NR, Beven EG, O'Hara PJ, et al. A prospective study of vein patch angioplasty during carotid endarterectomy: three year results for 801 patients and 917 operations. Ann Surg. 1987;206:628-635.
10. Katz MM, Jones GT, Degenhardt J, et al. The use of patch angioplasty to alter the incidence of carotid restenosis following thromboendarterectomy. J Cardiovasc Surg. 1987;28:2-8.
11. Lord RS A, Raj TB, Stary DL, et al. Comparison of saphenous vein patch, polytetrafluoroethylene patch, and direct arteriotomy closure after carotid endarterectomy. Part I. Perioperative results. J Vasc Surg. 1989;9:521-529.
12. Archie JP Jr. Early and late geometric changes after carotid endarterectomy patch reconstruction. J Vasc Surg. 1991;14:258-266.
13. McCollum CH, Wheeler WG, Noon G, et al. Aneurysms of the extracranial carotid artery. Twenty-one years' experience. Am J Surg. 1979;137:196-200.
14. Zhou W, Lin PH, Bush RL, et al. Carotid artery aneurysm: evolution of management over two decades. J Vasc Surg. 2006;43:493-496.
15. New G, Roubin GS, Iyer SS, et al. Safety, efficacy, and durability of carotid artery stenting for restenosis following carotid endarterectomy: a multicenter study. J Endovasc Ther. 2000;7:345-352.
16. AbuRahma AF, Jennings TG, Wulu JT, et al. Redo carotid endarterectomy versus primary carotid endarterectomy. Stroke. 2001;32:2787-2792.
17. Ricotta JJ, O'Brien MS, DeWeese JA. Natural history of recurrent and residual stenosis after carotid endarterectomy: implications for postoperative surveillance and surgical management. Surgery. 1992:112:656-661.
18. Ricotta JJ, O'Brien-Irr MS. Conservative management of residual and recurrent lesions after carotid endarterectomy: long-term results. J Vasc Surg. 1997;26:963-970.
19. Braun IF, Battey PM, Fulenwider JT, et al. Transcatheter carotid occlusion: an alternative to the surgical treatment of cervical carotid aneurysms. J Vasc Surg.1986;4:299-302.
20. Benndorf G, Campi A, Schneider GH, et al. Overlapping stents for treatment of a dissecting carotid artery aneurysm. J Endovasc Ther. 2001;8:566-570.
21. Bush RL, Lin PH, Dodson TF, et al. Endoluminal stent placement and coil embolizatin for the management of carotid artery pseudoaneurysms. J Endovasc Ther. 2001;32: 824-828.
22. Holder R, Hilton D, Martin J, et al. Percutaneous thrombin injection of carotid artery pseudoaneurysm. J Endovasc Ther. 2002;9:25-28.
23. Puech-Leão P, Amim Orra H. Endovascular repair of an innominate artery true aneurysm. J Endovasc Ther. 2001;8:429-432.
24. Simionato F, Righi C, Melissano G, et al. Stent-graft treatment of a common carotid artery pseudoaneurysm. J Endovasc Ther. 2000;7:136-140.
25. Tseng A, Ramaiah V, Rodriguez-Lopez JA, et al. Emergent endovascular treatment of a spontaneous internal carotid artery dissection with pseudoaneurysm. J Endovasc Ther. 2003;10:643-646.
26. Fischer B, Palkovic S, Wassmann H, et al. Endovascular management of tandem extracranial internal carotid artery aneurysms with a covered stent. J Endovasc Ther. 2004;11:739-741.
27. Kubaska SM III, Greenberg RK, Clair D, et al. Internal carotid artery pseudoaneurysms: treatment with the wallgraft endoprosthesis. J Endovasc Ther. 2003;10:182-189.
28. Smith TP, Alexander MJ, Enterline DS. Delayed stenosis following placement of a polyethylene terephthalate endograft in the cervical carotid artery. Report of three cases.
J Neurosurg. 2003;98:421-425.
29. Whittaker DR, McCullough JP, Wyers MC, et al. Shifting Wallgraft position: case reports and review of the forces affecting Wallgraft positioning. J Vasc Surg. 2006;43:383-387.
30. Assadian A, Senekowitsch C, Rotter R, et al. Long-term results of covered stent repair of internal carotid dissections. J Vasc Surg. 2004;40: 484-487.
31. Powell RJ, Rzucidlo EM, Schermerhorn ML. Stent-graft treatment of a large internal carotid artery vein graft aneurysm. J Vasc Surg. 2003;37:1310-1313.
32. Longo GM, Kibbe MR. Aneurysms of the carotid artery. Semin Vasc Surg. 2005;18:178-183.
33. Gupta K, Dougherty K, Hermman H, et al. Endovascular repair of a giant carotid pseudoaneurysm with the use of Viabahn stent graft. Catheter Cardiovasc Interv. 2004;62:69-70.