AN ALTERNATIVE PROCEDURE OF ENDOVASCULAR STENT-GRAFT REPAIR FOR DISTAL ARCH AORTIC ANEURYSM INVOLVING ARCH VESSELS

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Although endovascular stent-graft repair for thoracic aortic aneurysm is less invasive than open surgical procedures, the presence of involving branch vessels in the aortic arch makes it difficult to apply this method in aortic arch disease. Distal arch aneurysm involving arch vessels is not a rare disease. We report on a safe, easy, and effective method for endovascular stent-graft repair and reconstruction of the left subclavian artery with the use of a unique perfusion.

Clinical summary. A 64-year-old man who had a myocardial infarction of the left anterior descending artery was diagnosed with an aneurysm of the left subclavian artery. Two-year follow-up computed tomographic (CT) scan revealed that the aneurysm developed gradually in size. He was admitted to our hospital.

Angiography showed a saccular-type aneurysm (45 mm in diameter) on the left subclavian artery and multiple aneurysmal projections in lesser and greater curvature in the distal aortic arch (Fig 1, A and Fig 2, A). Body CT scans demonstrated severe calcified plaque on the ascending aorta and an abdominal aortic aneurysm (AAA), 40 mm in diameter, with mural thrombus. The diagnosis was distal arch aortic aneurysm involving the arch vessels, and there were several risk factors: a coronary stent positioned in the left anterior descending artery, calcified plaque on the ascending aorta, and AAA with mural thrombus. Thus, endovascular stent-graft repair was performed with antegrade systemic perfusion through the right subclavian artery.

The right subclavian artery was dissected and clamped. A gelatin-sealed knitted Dacron prosthesis (8-mm diameter, Zelsoft, Vascutek, Scotland) was anastomosed in an end-to-side fashion to the artery. Then a median sternotomy was done. Cardiopulmonary bypass (CPB) was established with the right atrial vein drainage and the right subclavian arterial cannula through the conduit. Selective cerebral perfusion (SCP) was performed through arterial cannula to the left common carotid artery and the right subclavian artery. The proximal site of the brachiocephalic artery and the distal site of the aneurysm of the left subclavian artery were clamped, and SCP was started. During the cooling of the body, the left subclavian artery was ligated and divided at the distal site of the aneurysm. The perfusate was cooled until the patient had a rectal temperature of 25°C. Hypothermic circulatory arrest was obtained. A liner oblique incision (3 cm in length) was made on the anterior wall of the aortic arch (Fig 1, B). A Gianturco stainless steel Z stent (Cook, Inc, Bloomington, Ind) was inserted into a thin-walled Dacron graft with a diameter of 26 mm (Intervascular Medicals, Intervascular Inc, Clearwater, Fla) and sutured onto the interior wall of the graft. This stent-graft was introduced into a sheath catheter with a 30F diameter. The sheath catheter was inserted via the incision on the aortic arch and deployed with the guidance of transesophageal echocardiography (Fig 1, C). The stent was fully opened by means of a 20F Foley balloon. The proximal site of the graft was sutured circumferentially to the aortic wall of the arch aorta. After the incision was closed with Dacron felt strips and the clamp was removed from the brachiocephalic artery, systemic perfusion through the right subclavian artery was restarted. During rewarming, the cannula of the left common carotid artery was removed and SCP was finished. The body was rewarmed and the heart began to spontaneously pulsate. Weaning of CPB was uneventful. After administration of protamine, the distal side of the conduit was anastomosed to the left subclavian artery in end-to-end fashion and the right subclavian–left subclavian artery bypass was completed (Fig 1, D). The postoperative course was uneventful. Postoperative angiography showed patency of the bypass and no endoluminal leakage from the stent-graft. The

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Received for publication April 28, 2000; accepted for publication June 15, 2000.

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J Thorac Cardiovasc Surg 2001;121:182-4

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0022-5223/2001 \$35.00 + 0 12/54/109545

doi:10.1067/mtc.2001.109545

Fig 1. Schema of endovascular stent-graft repair with right subclavian arterial perfusion through a conduit. **A**, Preoperative condition. **B**, A conduit is anastomosed to the right subclavian artery, and a cannula is inserted to the common carotid artery. **C**, A sheath containing the stent-graft is inserted through the linear incision site on the aortic arch, and the sheath is withdrawn. **D**, Postoperative condition: closure of the incision line is made, and the conduit is anastomosed to the left subclavian artery.

Fig 2. **A**, Preoperatively, aortography revealed aneurysms of distal aortic arch and left subclavian artery. **B**, Postoperatively, aortography demonstrated elimination of the aneurysms.

aneurysm of the left subclavian artery and other aneurysms were opacified (Fig 2, B).

Comment. Various endovascular stent-graft techniques have become viable therapeutic alternatives for patients with descending thoracic aortic aneurysm. These techniques are less invasive and are associated with acceptable morbidity and mortality rates.¹ We have also performed endovascular stent-grafting to distal arch aortic aneurysm.² Central nervous system complications during thoracic aortic surgery have remained critical. Their occurrence has been predominant in postoperative mortality and morbidity. Our principal strategies to reduce the complications are (1) SCP, (2) antegrade systemic perfusion, and (3) non-clamp of the ascending aorta using circulatory arrest.

AAA with mural thrombus was observed in this case. We planned less-invasive repair with antegrade systemic perfusion to avoid retrograde embolism from the abdominal aorta. We chose stent-graft therapy and the right arterial cannulation through a conduit because of existence of calcified plaques on the ascending aorta. Sabik and associates³ reported the efficacy of subclavian arterial cannulation (ie, direct cannulation into the right subclavian artery). We also performed the right subclavian arterial cannulation through a prosthesis sutured to the right subclavian artery. This method is less invasive, and the conduit is available for the bypass to reconstruct the left subclavian artery after CPB. In addition, SCP can be established via the conduit only by clamping the brachiocephalic artery during circulatory arrest. Only another cannula to the left carotid artery is necessary for SCP.

Kato and associates⁴ proposed stent-graft repair and aorta–left subclavian artery bypass to treat distal arch aneurysm involving arch vessels. Their method is inexpensive because it requires no extracorporeal circulation. A side clamp of the ascending aorta, which seems to be one of the risk factors for intraoperative cerebral complications, is mandatory. Compared with their method, ours has the advantage of creating less possibility for cerebral complications. This is an alternative procedure for treating distal arch aortic aneurysm involving arch vessels.

REFERENCES

1. Mitchell RS, Dake MD, Semba CP, Fogarty TJ, Zarins CK, Liddell RP, et al. Endovascular stent-graft repair of thoracic aortic aneurysms. *J Thorac Cardiovasc Surg* 1996;111:1054-62.
2. Sueda T, Watari M, Orihashi K, Shikata H, Matsuura Y. Endovascular stent-grafting via the aortic arch for chronic aortic dissection combined with coronary artery bypass grafting. *J Thorac Cardiovasc Surg* 1999;117:825-7.
3. Sabik JF, Lytle BW, McCarthy PM, Cosgrove DM. Axillary artery: as alternative site of arterial cannulation for patients with extensive aortic and peripheral vascular disease. *J Thorac Cardiovasc Surg* 1995;109:885-91.
4. Kato M, Kaneko M, Kuratani T, Horiguchi K, Ikushima H, Ohnishi K. New operative method for distal aortic arch aneurysm: combined cervical branch bypass and endovascular stent-graft implantation. *J Thorac Cardiovasc Surg* 1999;117:832-4.