NEW OPERATIVE METHOD FOR DISTAL AORTIC ARCH ANEURYSM: COMBINED CERVICAL BRANCH BYPASS AND ENDOVASCULAR STENT-GRAFT IMPLANTATION

Masaaki Kato, MD, Mitsunori Kaneko, MD, Toru Kuratani, MD, Kei Horiguchi, MD, Hirofumi Ikushima, MD, and Kenji Ohnishi, MD, *Osaka, Japan*

Surgical treatment of distal aortic arch aneurysm still results in many problems: direct lung injury, phrenic or recurrent nerve paralysis, cerebrovascular complications, and clotting disturbances.^{1,2} Although endoluminal stent-graft implantation for thoracic aortic aneurysm is less invasive,^{3,4} the curve of the aortic arch and the need to maintain supply to the cerebral branches make it difficult to apply this approach in the case of distal arch aneurysm. Therefore we have developed and now applied a new stent-graft implanting method that uses cervical branch bypasses from the ascending aorta and requires no extracorporeal circulation (ECC) and no aortic crossclamping.

Clinical summary. The patient was a 76-year-old man with an abdominal and a thoracic aneurysm. A preoperative computed tomographic scan and aortography showed a sacular aneurysm in the distal aortic arch and an ulcerlike projection in its lesser curve (Fig 1, *A* and *B*). Seventeen years earlier, he had had a cerebral infarction. Magnetic resonance imaging documented many infarcts in the deep white matter, but magnetic resonance angiography, a Matas test, and a cerebral scintiscan demonstrated good patency of the Willis arterial circle and indicated that the carotid artery could be safely occluded. An operation to repair the thoracic aneurysm was performed 3 months after the repair of the abdominal aneurysm.

After a median sternotomy and partial clamping of the ascending aorta, the main portion of 16 × 8 mm in diameter bifurcated woven Dacron graft (Meadox Medicals, Inc, Oakland, NJ) was anastomosed to the ascending aorta with 4-0 Prolene suture (Ethicon, Inc, Somerville, NJ) (Fig 2, *A*). The distal ends of the graft were used as bypasses to the left subclavian and left carotid arteries and attached with a simple clamp (Fig 2, *B*). Via the main portion of the graft, a curved 30F sheath was then fluoroscopically guided through the aortic arch to the descending aorta (Fig 2, *B*). A specially devised

From the Division of Cardiovascular Surgery, Osaka Prefectural Hospital, Osaka, Japan.

Received for publication Nov 23, 1998; accepted for publication Nov 27, 1998.

Address for reprints: Masaaki Kato, MD, Division of Cardiovascular Surgery, Osaka Prefectural Hospital, 3-1-56 Mandai-higashi, Sumiyoshiku Osaka 558-8558, Japan.

J Thorac Cardiovasc Surg 1999;117:832-4

Copyright © 1999 by Mosby, Inc.

0022-5223/99 \$8.00 + 0 12/54/96202

Fig 1. Preoperative (**A** and **B**) and postoperative (**C** and **D**) aortograms and computed tomograms. **A**, Preoperative aortogram shows the saccular projection in the distal aortic arch (*large arrow*) and small ulcer-like projection (*small arrows*) in the lesser curve. **B**, Enhanced computed tomogram shows the sacular aneurysm with thrombus in the distal arch. **C**, Postoperative aortogram shows bypasses to the left carotid artery and left subclavian artery, and stent-graft implanted in the arch–descending aorta. **D**, Postoperative computed tomogram shows the clot formation in the sacular projection that was excluded by the stent-graft.

Fig 2. Schema of the new stent-graft implantation method for distal aortic arch aneurysm. **A**, The main portion of the bifurcated graft is anastomosed to the ascending aorta. **B**, After bypasses have been established to the left carotid and left subclavian arteries, a 30F sheath containing the specially devised stent-graft is inserted, extending from the ascending aorta to the descending aorta. **C**, The stent-graft is deployed from the aortic arch to the descending aorta.

stent-graft, composed of a specially made knitted Dacron graft (28 mm) and Gianturco stent (GZV30-50, GZV 30-75; William Cook Europe), was deployed via the sheath. In both the proximal aortic arch and the distal descending aorta, the stent-graft was anchored by its expansile force against the aortic walls (Fig 2, C). Aortography and transesophageal echocardiography confirmed exclusion of the aneurysm.

After extubation (postoperative day 1), no central nervous system, lung, or renal complications were observed. Postoperative aortography (postoperative day 10) revealed that the saccular aneurysm had disappeared, including the ulcer-like projection of the lesser curve, and the computed tomographic scan showed complete clot formation in the excluded aneurysm (Fig 1, C and D).

Comment. This operative approach represents two advances. First, it is less invasive than previous techniques. In 1995 we had begun substituting the stent-graft for distal anastomosis in the repair of aortic arch disease.⁵ Although this method reduced the complications associated with suture anastomosis in the descending aorta and decreased the mortality and morbidity of aortic arch surgery, it remained quite invasive because of hypothermic ECC and circulatory arrest distal to the left subclavian artery. The new method does not require ECC or aortic crossclamping, and substituting the stent-graft for proximal suture anastomosis avoids distal malperfusion.

Second, it avoids proximal perigraft leakage, which often

accompanies aortic transcatheter stent-graft implantation via the femoral artery.^{3,4} The main cause of the leakage is incomplete attachment of the stent-graft because of an insufficiently large attachment area between the stent-graft and aortic wall, as well as the curve just distal to the left subclavian artery. Our new method solves this problem by providing a long, straight attachment area between the stent-graft and aortic wall via bypass from the ascending aorta to the left carotid and left subclavian arteries.

REFERENCES

1. Miller DC, Mitchell RS, Oyer PE, Stinson EB, Jamieson SW, Shumway NE. Independent determinant of operative mortality for patients with aortic dissections. *Circulation* 1984;70(Suppl): I152-64.
2. Coselli JS, Buket S, Djukanovic B. Aortic arch operation: current treatment and results. *Ann Thorac Surg* 1995;59:19-26.
3. Dake MD, Miller DC, Semba CP, Mitchell RS, Walker PJ, Liddle RP. Transluminal placement of endovascular stent-grafts for the treatment of descending thoracic aortic aneurysm. *N Engl J Med* 1994;331:1729-34.
4. Mitchell RS, Dake MD, Semba CP, Fogarty TJ, Zarins CK, Liddle RP, et al. Endovascular stent-graft repair of thoracic aortic aneurysms. *J Thorac Cardiovasc Surg* 1996;111:1054-62.
5. Kato M, Ohnishi K, Kaneko M, Ueda T, Kishi D, Mizushima T, et al. A new grafting-implanting method for thoracic aortic aneurysm or dissection with a stented graft. *Circulation* 1996; 94(Suppl):II188-93.