Transapical thoracic endovascular aortic repair in aortic arch aneurysm through a pre-existent bioprosthetic aortic valve

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ABSTRACT

An 80-year-old man had undergone Y-graft replacement for ruptured abdominal aortic aneurysm followed by bioprosthetic aortic valve replacement. Follow-up computed tomography revealed a 65-mm aneurysm at the distal aortic arch. We selected endovascular surgery because of the patient's high-risk condition, and the extreme curvature of the 8-mm artificial blood vessels led us to adopt a transapical approach. No signs of deterioration of the bioprosthesis were noted, and the patient's hemodynamic condition remained stable during surgery. Transapical thoracic endovascular aortic repair through a pre-existent aortic bioprosthesis is an efficient alternative approach for treating aortic aneurysm, even after bioprosthetic aortic valve replacement. (J Vasc Surg Cases and Innovative Techniques 2018;4:265-7.)

Keywords: Transapical; TEVAR; Endovascular aortic repair

Thoracic endovascular aortic repair (TEVAR) has been established as an effective method to treat thoracic aortic aneurysm because of the improvement of the low-profile device and implantation technique. However, we still encounter cases with problems of delivery access from anatomic causes. We report the rare case of transapical TEVAR (TaTEVAR) through a pre-existent aortic bioprosthetic valve to treat an aortic arch aneurysm. This is the first case in our institute, and the patient consented to publication of this report.

CASE REPORT

An 80-year-old man had undergone Y-graft replacement when he was 75 years old for abdominal aortic aneurysm rupture with an artificial graft of 16 × 8 mm followed by aortic valve replacement with a 23-mm Carpentier-Edwards prosthetic valve (Edwards Lifesciences, Irvine, Calif). Follow-up computed tomography revealed a 65-mm aneurysm at the distal aortic arch and deformation of the esophagus due to compression by the large aneurysm, requiring further surgical intervention. At admission, the patient's general condition was fair, and his European System for Cardiac Operative Risk Evaluation (EuroSCORE II) was 7.9%.

Extreme curvature of the bilateral iliac portions at <8 mm in the Y-graft (Fig 1) led us to adopt a transapical approach rather than a transfemoral approach. Based on the anatomic findings of the aortic aneurysm, we decided to perform debranching of the aortic arch vessels and TEVAR. Preoperative echocardiography showed no issues with the bioprosthetic valve function, with an effective valve opening area of 1.37 cm^2, or the cardiac function, with an ejection fraction of 66%.

During surgery, given the anatomic position of the aortic aneurysm, we performed bypass with the goal of debranching the left common carotid artery and the left subclavian artery. The T-shaped artificial blood vessel was end-to-side anastomosed to the right subclavian artery. The artificial blood vessel was end-to-end anastomosed to the left common carotid artery. The artificial blood vessel was end-to-side anastomosed to the left subclavian artery, and the base of the left subclavian artery was occluded by an Amplatzer vascular plug I (St. Jude Medical Japan Co, Ltd, Tokyo, Japan). The cardiac apex was exposed through the fifth intercostal space. The apex was doubly sutured in a triangle fashion with a pair of 3-0 monofilament sutures, and a 22F DrySeal introducer sheath (W. L. Gore & Associates, Flagstaff, Ariz) was placed inside the left ventricle. Using an ultrastiff wire (Cook Medical, Bloomington, Ind), one GORE TAG (34 × 34 × 200 mm; W. L. Gore & Associates) was deployed at the height of the ninth thoracic vertebra, and another GORE TAG (37 × 37 × 200 mm) was deployed just distal from the innominate artery (Fig 2), with care taken to hold it in position so that the thread used for the deployment did not brush against the bioprosthetic valve. No bioprosthetic valve dysfunction was noted during the procedure by transesophageal echocardiography monitoring. No signs of endoleak were noted, and the patient's hemodynamic condition remained stable during surgery.

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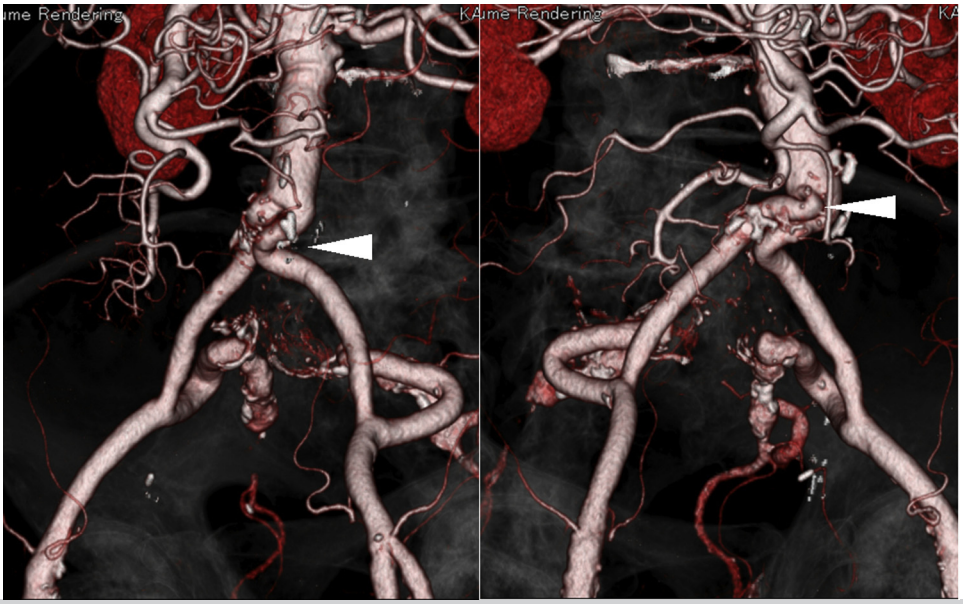

Fig 1. Three-dimensional computed tomography revealed that the bilateral iliac leg of 8 mm of the Y-graft was extremely kinked (*arrowheads*).

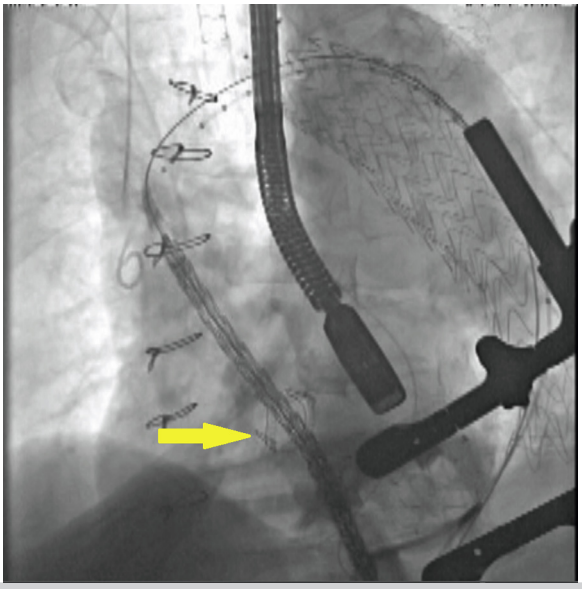

Fig 2. The stent graft is passing through a bioprosthetic valve (*arrow*).

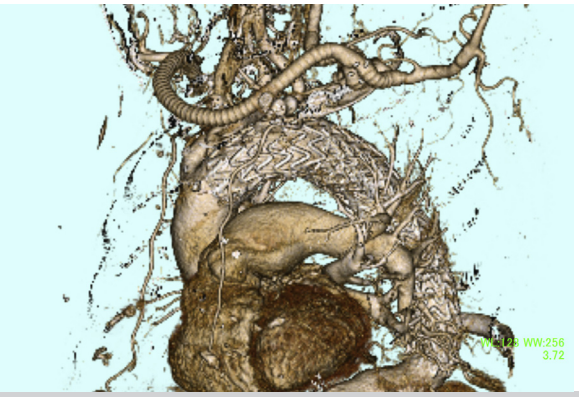

Fig 3. No endoleak was observed on postoperative contrast-enhanced computed tomography.

After surgery, a transthoracic echocardiogram revealed an effective aortic valve area of 1.90 cm^2 without bioprosthetic valve dysfunction and no signs of left ventricular aneurysm formation at the apex. Postoperative contrast-enhanced computed tomography showed no signs of endoleak (Fig 3) or other complications. The patient was discharged home 14 days after surgery in a satisfactory condition.

DISCUSSION

Endovascular aortic repair has been established as an effective therapy for thoracic aortic aneurysm. Despite reductions in the profile of the delivery device and improvements in the procedural technique, we still encounter cases in which delivery access is difficult because of anatomic issues. TaTEVAR was initially reported by Grenon et al[1] in 2009 in pig models. Since then, there have been several reports describing TaTEVAR in patients in whom access is difficult.[2-5] We considered the femoral artery approach at first. However, because we previously experienced a case in which a hard sheath could not be promoted because of kinking of the artificial blood vessel, we chose the transapical approach in this patient.

Ramponi et al[6] pointed out that rapid ventricular pacing should be used during deployment in TaTEVAR to stabilize the movement of the stent graft itself. Preparations should also be made to prevent hemodynamic deterioration due to outflow tract stenosis or acute aortic regurgitation when the system occupies the aortic

prosthesis. To accomplish TaTEVAR successfully, surgeons should be alert to the potential risk of type IA endoleak from the distal portion of the stent graft, as the stent graft itself is normally arranged to avoid type IA endoleak from the proximal portion. We should also endeavor to use a stent graft attached with a bare stent in the proximal portion because in the TaTEVAR procedure, the graft is placed in a reversed fashion, with the bare stent portion located at the distal position.

The device used in our patient was a 22F Gore DrySeal with an external diameter of 8.3 mm and area of 0.54 cm^2, which could potentially pass through the bioprosthesis. The aortic valve area of the bioprosthesis measured by transthoracic echocardiography was 1.37 cm^2. We therefore ensured that the theoretical valve area was 0.83 cm^2 ($= 1.37 - 0.54$) if the sheath were to pass through the aortic valve coaxially. All devices that pass through the bioprosthetic valve must also be carefully considered to minimize any potential damage to the bioprosthetic valve. If acute bioprosthetic valve dysfunction appeared, we were planning to perform a transapical valve-in-valve procedure rather than conventional aortic valve replacement. In addition, the cardiac surgical team and the team performing this procedure were the same team, and the procedure was conducted in such a way that the approach could be promptly changed. We informed the patient of these points before surgery.

Neither cerebral nor vascular complications have been reported with TaTEVAR.[7,8] However, some complications have still been reported after TaTEVAR, including hemorrhage from the apical puncture site, pseudoaneurysm formation at the apical region, and injury of the ventricular septum. Careful serial follow-up and observation are needed to detect any complications after TaTEVAR.

CONCLUSIONS

We herein report a fairly rare case of TaTEVAR performed through a bioprosthetic aortic valve. As long as we correctly evaluate that the delivery device can safely pass through a biologic valve and overcome disadvantages caused by the reverse placement of the stent graft from the apex, TaTEVAR can be considered a safe and efficient alternative therapeutic strategy for patients unsuited for normal deployment through the lower body, even in patients with a pre-existent aortic bioprosthesis.

REFERENCES

1. Grenon SM, MacDonald S, Sidhu RS, Reid JD, Cheung A, Hsiang Y, et al. Successful ventricular transapical thoracic endovascular graft deployment in a pig model. J Vasc Surg 2008;48:1301-5.
2. MacDonald S, Cheung A, Sidhu R, Rheaume P, Grenon SM, Clement J. Endovascular aortic aneurysm repair via the left ventricular apex of a beating heart. J Vasc Surg 2009;49:759-62.
3. Szeto WY, Moser WG, Desai ND, Milewski RK, Cheung AT, Pochettino A, et al. Transapical deployment of endovascular thoracic aortic stent graft for an ascending aortic pseudoaneurysm. Ann Thorac Surg 2010;89:616-8.
4. Kappert U, Ouda A, Ghazy T, Simonis G, Matschke K. Transapical endovascular deployment of a stent-graft in the thoracic descending aorta. Ann Thorac Surg 2012;93:2063-5.
5. Uthoff H, Covarrubias LG, Samuels S, Benenati JF, Moreno NL, Katzen BT. Transapical endovascular aortic repair to treat complex aortic pathologies. Ann Thorac Surg 2012;93:1735-7.
6. Ramponi F, Stephen MS, Wilson MK, Vallely MP. Think differently: trans-apical platform for TEVAR. Ann Cardiothorac Surg 2012;1:412-6.
7. Stortecky S, Windecker S, Pilgrim T, Heg D, Buellesfeld L, Khattab AA, et al. Cerebrovascular accidents complicating transcatheter aortic valve implantation: frequency, timing and impact on outcomes. EuroIntervention 2012;8:62-70.
8. Eggebrecht H, Schmermund A, Voigtländer T, Kahlert P, Erbel R, Mehta RH. Risk of stroke after transcatheter aortic valve implantation (TAVI): a meta-analysis of 10,037 published patients. EuroIntervention 2012;8:129-38.

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