Transaortic Access Using Vascular Graft for Transcatheter Aortic Valve Implantation

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Summary
A 92-year-old man with acute heart failure due to severe aortic stenosis underwent transcatheter aortic valve implantation (TAVI). Computed tomography demonstrated severe stenosis of the right common iliac artery, occlusion of the left external iliac artery, and stenosis of the left subclavian artery. Severe calcification was observed in the sinotubular junction, which was considered a risk factor for aortic dissection with transapical TAVI using a balloon-expanding bioprosthetic valve. Therefore, transaortic (TAo) access was the only option for this high-risk surgical patient. As the maximum distance from the aortic valve annulus to the sheath insertion point was less than 60 mm, TAVI was performed transaortically using a vascular graft that extended this distance, in order to avoid sheath dislocation. Our experience demonstrates that vascular graft application is a viable option in patients with an inadequate distance between the aortic valve annulus and the puncture site in TAo-TAVI.

Key words: CoreValve Evolut-R, Transaortic TAVI, Alternative access, Direct aortic access

Transcatheter aortic valve implantation (TAVI) is an alternative to surgical aortic valve replacement (SAVR) in high-risk patients with aortic stenosis (AS).1,2 The transfemoral (TF) access route is most commonly used for the TAVI procedure.3-5 Alternative access routes, including the transapical (TA) and transsubclavian (TS) routes, are also used in patients with severe peripheral vasculopathy. Transaortic (TAo) access is yet another practical approach when the TF, TA, and TS access routes are not suitable.4,6 In TAo access, a sufficient distance between the aortic valve annulus and the sheath is necessary for TAVI to be conducted safely, particularly for self-expanding bioprosthetic valve implantation.6 However, the anatomy may vary among patients, and the distance between the sheath insertion point and the aortic valve annulus may not always be adequate.7 We herein report a case of TAo-TAVI in which a vascular graft that extended the distance between the aortic valve annulus and the sheath insertion point was used to avoid sheath dislocation.

Case Report
A 92-year-old man with acute heart failure due to severe AS. TAVI was the only option available for this patient, as he was a high-risk patient for SAVR (logistic EuroSCORE: 18.3%; Society of Thoracic Surgeons predicted risk of mortality: 11.2%).

Computed tomography (CT) demonstrated severe calcification and stenosis of the peripheral arteries (Figure 1A), whereas aortography showed severe stenosis of the right common iliac artery (Figure 1B) and occlusion of the left external iliac artery (Figure 1C). Left subclavian artery stenosis with calcification was also noted on the CT (Figure 1D). Therefore, the TF and TS access routes were deemed unsuitable for the present case, owing to the anatomy of the patient’s vascular access. In addition, severe calcification was observed in the sinotubular junction, which could be an important risk factor for aortic dissection in TA- and TAo-TAVI with a balloon-expanding bioprosthetic valve of 26-mm diameter (Figure 1E). As the maximum distance between the aortic valve annulus and the sheath insertion point was only 59.5-mm (because of severe calcification in the upper ascending aorta; Figure 1F), we decided to perform TAo-TAVI with a self-expanding bioprosthetic valve using a vascular graft, in order to secure an appropriate length for safe sheath manipulation.

The procedure was performed under general anesthesia and mechanical ventilation. A reverse L-shaped lower hemisternotomy from the right second intercostal space to the xiphoid process was performed. A 5-Fr pigtail catheter with a metal marker (Medikit Ltd., Tokyo, Japan) was inserted through the left radial artery. An epicardial pacing lead was then placed on the diaphragmatic surface of the
right ventricle. Aortography was performed to measure a distance of 60 mm from the aortic annulus. At the entry site, a 10-mm diameter vascular graft (Gelweave; Vascutek Ltd., Renfrewshire, Scotland) was sutured to the ascending aorta at an angle of 45° under a partial aortic clamp (Figure 2A, B). After the insertion of an 18 Fr DrySeal sheath (W. L. Gore and Associates, Flagstaff, AZ, USA) into the vascular graft, the native aortic valve was predilated with a 20-mm Z-MED II balloon (NuMED Inc., Hopkinton, NY, USA). A 29 mm CoreValve Evolut-R (Medtronic Inc., Minneapolis, MN, USA) bioprosthetic valve was subsequently implanted (Figures 2C, 3). Transesophageal echocardiography demonstrated only mild paravalvular leakage, and aortography showed mild aortic regurgitation with patent coronary arteries. The vascular graft was ligated and resected after sheath extraction (Figure 2D). The duration of the procedure was 188 minutes, and the patient’s clinical course was uneventful.

Discussion

Herein, we reported the case of a patient with peripheral vasculopathy and inadequate distance of the sheath insertion point from the aortic valve annulus, for which TAo-TAVI using a vascular graft was performed. In patients with severe peripheral vasculopathy, TA access is typically the first option for TAVI. However, in their meta-analysis, Dunne et al. demonstrated a lower incidence of cerebrovascular events and equivalent 30-day mortality in TAo-TAVI as compared with TA-TAVI. In terms of bleeding, Kochman et al. reported that severe bleeding events were associated not with TAo access but with TS access. On the other hand, TA access was associated with site-specific complications, such as left ventricular bleeding, akinesia of the apex, and aneurysm formation. Therefore, TAo access may be more favorable as there is no direct myocardial injury. Furthermore, TAo access is useful for patients undergoing combined TAVI and off-pump coronary artery bypass graft surgery. Kobayashi et al. reported the safety of TAo-TAVI and off-pump coronary artery bypass graft surgery in their 12 cases. TAo access should be used in suitable patients undergoing TAVI.

TAo-TAVI is a viable option for patients in whom the TF, TA, and TS access routes are not suitable. Jagielak et al. reported that TAo-TAVI is a safe alternative to the TF and TA approaches, particularly for high-risk patients in the case of peripheral vessel access. On the other hand, the suitability for TAo-TAVI may be limited by the anatomy of the ascending aorta. Bapat et al. reported that a favorable aortic anatomy at the sheath insertion point for TAo-TAVI (1) is free of calcification, (2) is in a straight line to the aortic valve annulus to deploy the device, and (3) has enough distance between the tip of the sheath and the native aortic valve annulus. When using the CoreValve Classic, the sheath insertion point requires a distance of 60-70 mm from the aortic valve annulus, as the final height of the CoreValve Classic is 52-55 mm.
Figure 2. Operative field and angiogram during transcatheter aortic valve implantation. A 10-mm diameter vascular graft was sutured to the ascending aorta at an angle of 45° (A). The suturing site (arrow) was determined under catheter guidance (B). A self-expanding valve was implanted under angiographic guidance (C). The vascular graft was resected and ligated after sheath extraction (D).

Figure 3. Perspective image after valve implantation. A self-expanding bioprosthetic valve was successfully implanted through transaortic access with a vascular graft.

though the final height of the CoreValve Evolut-R is slightly shorter (45 mm without paddle) than that of the CoreValve Classic, a similar distance is required between the aortic valve annulus and the sheath insertion point in order to avoid sheath dislocation. It was demonstrated that the frequency of diffuse calcification at the sheath insertion point for TAo-TAVI was extremely low in all patients undergoing TAVI.19 However, calcification at the sheath insertion point may be more frequent in patients undergoing TAo-TAVI, because these patients may have severe calcification in the ascending aorta. In the present case, the distance of the sheath insertion point from the aortic valve annulus was inadequate, owing to severe calcification in the upper ascending aorta. Therefore, it was necessary to extend this distance using a vascular graft for the margin of safety. Finally, we successfully implanted a self-expanding aortic bioprosthetic valve safely through the T Ao access using a vascular graft. Our experience indicates that TAo-TAVI with vascular graft application could be an option when the distance between the annulus and the puncture site is insufficient. In this technique, bleeding complications, which are common in TAo-TAVI during the manipulation of the delivery sheath, can be avoided by
securely ligating the vascular graft with a delivery sheath inside. Precise evaluation of the location and angle of the anastomosis between the vascular prosthesis and the aorta on preoperative CT images and intraoperative confirmation of adequacy using fluoroscopy are the keys to success. Needless to say, thorough examinations of calcification and atheroma in the aortic lumen through an epiaortic scan and gentle clamping are essential to avoid complications (including stroke) associated with aortic clamping. In conclusion, vascular graft application may be a useful option in patients with an inadequate distance from the annulus to the puncture site in TAo-TAVI.

Disclosure

Conflicts of interest: None.

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