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Successful Aortic Valve Replacement With Perceval Bioprosthesis for Aortic Stenosis With Membranous Ventricular Septum Aneurysm

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Abstract

Membranous ventricular septum aneurysm (MVSA) is extremely rare, especially when coexisting with aortic stenosis (AS), and reports regarding the available treatment for MVSA with AS are limited. Aortic valve replacement (AVR) can be challenging because of anatomical reasons. In this case report, a patient with MVSA and severe AS was treated with AVR with the sutureless Perceval bioprosthesis. After implantation, no paravalvular leakage was detected in echocardiography, and no other postoperative complications were observed. Postoperative electrocardiography-gated computed tomography revealed no contrast enhancement for MVSA. The MVSA was closed by the Perceval bioprosthetic valve. Thus, patients with simultaneous MVSA and AS may be effectively treated with AVR using a Perceval bioprosthesis.

Keywords

aortic valve replacement, Perceval bioprosthesis, aortic stenosis, membranous ventricular septum aneurysm

Introduction

The coexistence of membranous ventricular septum aneurysm (MVSA) and aortic stenosis (AS) is extremely rare,[1] and its treatment is seldom reported. However, Hawa et al.[2] reported the use of transcatheter aortic valve replacement (AVR) in a patient with AS and MVSA. Considering that MVSAs are located in the membranous septum right below the annulus, suturing a classical stented bioprosthetic valve may be unsafe. Meanwhile, Perceval bioprosthesis is a sutureless, self-expanding valve that is also used for AVR. The Perceval valve is a self-expanding, rapid deployment valve for surgical implantation. It is made from a laser-cut Nitinol frame with leaflets from bovine pericardium. It is delivered using guiding sutures that are removed before closing the aortotomy. Valve fixation is based on the self-expansion of the valve's inflow and outflow rings. The feasibility of AVR for AS with MVSA using a sutureless valve and the classical stented bioprosthetic valve remains unconfirmed.

In this report, we describe a successful AVR with Perceval bioprosthesis in a patient with severe AS and MVSA.

Case Report

A 77-year-old woman presented to our department with severe AS associated with MVSA. She had been receiving dialysis treatment for 2 years because of renal sclerosis. She underwent transthoracic echocardiography (TTE), which revealed a severe AS with a mean pressure gradient of 47 mmHg and a peak velocity of 4.12 m/s. In preoperative echocardiographic examination, normal left ventricular dimensions (end-diastolic diameter, 49.2 mm; end-systolic diameter, 32.4 mm) and preserved function (ejection fraction, 62.8%) were detected.

The anatomy and location of the MVSA can be best described by electrocardiography-gated computed tomography (ECG-CT). According to the ECG-CT, the MVSA was located at the point of left ventricular outflow, positioned right below the aortic valve commissure between the right coronary cusp and the noncoronary cusp (Fig. 1a-b). To reduce surgical trauma and cross-clamp time

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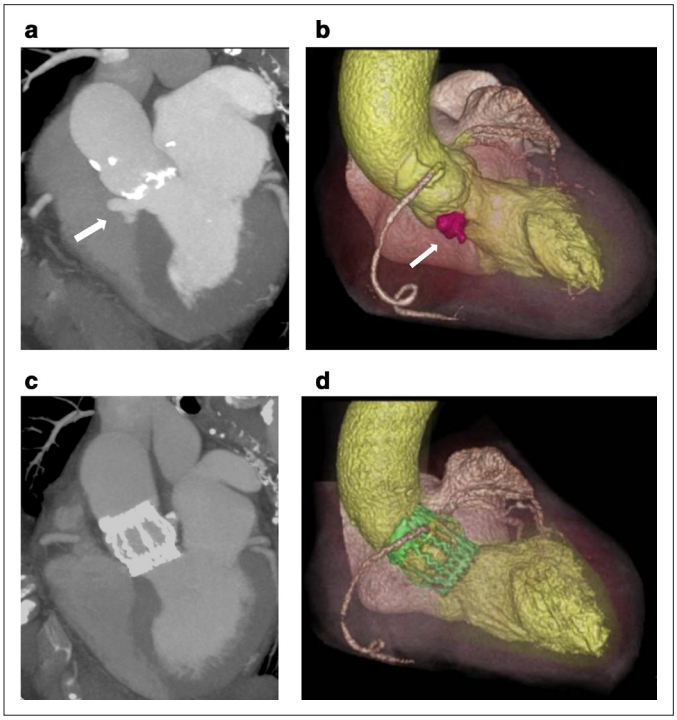

Fig. 1. (a, b) Preoperative cardiac computed tomographic image in the long axis (left) and 3-dimensional view (right), showing the membranous ventricular septal aneurysm (arrows) and its relationship to the aortic annulus. (c, d) Cardiac computed tomographic images after aortic valve replacement with a Perceval bioprosthesis in the long axis (left) and 3-dimensional (right) views, showing coverage of the membranous ventricular septal aneurysm and its relationship to the aortic annulus.

in addition to cardiopulmonary bypass (CPB) time, we chose to place an S-size Perceval sutureless valve (LivaNova, Milan, Italy) through minithoracotomy[3] because of the patient's need for hemodialysis (Supplemental Video).

Under general anesthesia, a 6-cm thoracotomy was made at the second intercostal space. CPB was established via cannulations in the right femoral artery and vein. We cross-clamped the ascending aorta and created a transverse aortotomy approximately 1 cm away from the sinotubular junction (STJ). After aortic valve resection, we examined the MVSA via thoracoscopy and deemed that AVR with Perceval bioprosthesis was feasible (Fig. 2). According to the 3 guiding sutures, the Perceval bioprosthesis was implanted in the usual manner[4] and its supra-annular cuff was placed on the nadir of the annulus. Thereafter, we inspected the deployment of the left ventricular outflow tract through the orifice of Perceval bioprosthesis; the MVSA was completely covered by the inflow ring of the valve. In intraoperative transesophageal echocardiography (TEE), the valve was successfully and firmly positioned, without any paravalvular leakage. The aortic cross-clamping and CPB lasted for 50 and 72 minutes, respectively. The patient remained in a stable sinus rhythm.

The patient's postoperative course was uneventful. Five days after AVR, TTE was performed and it demonstrated a mean gradient of 21 mm Hg and no paravalvular aortic insufficiency. Two months after AVR, ECG-CT demonstrated that the valve was well seated and sufficiently covered the MVSA (Fig. 1c-d).

Discussion

We performed AVR with Perceval bioprosthesis at the second intercostal space (second and third ribs) in a patient with severe AS and MVSA. This method was proven feasible, with the possibility of permanent MVSA closure.

MVSA is extremely rare, with only few patients being reported. Many MVSA instances occur when an original ventricular septal defect is closed. Two-thirds of ventricular septal defects involve the membranous part of the septum. The incidence of MVSA associated with ventricular septal defects has been varied in different reports. It was as high as 20% in some studies.[1] It is most commonly associated with corrected transposition of the great arteries. However, it may also result from infection, trauma, or other tissue anomalies.[1] Improvements in diagnostic imaging techniques, such as echocardiography and CT, have led to the occasional diagnosis of MVSA.[1] In fact, MVSA was diagnosed via TTE in this patient.

The use of surgical AVR for patients with AS and MVSA is currently unreported. In these patients, suturing a surgical

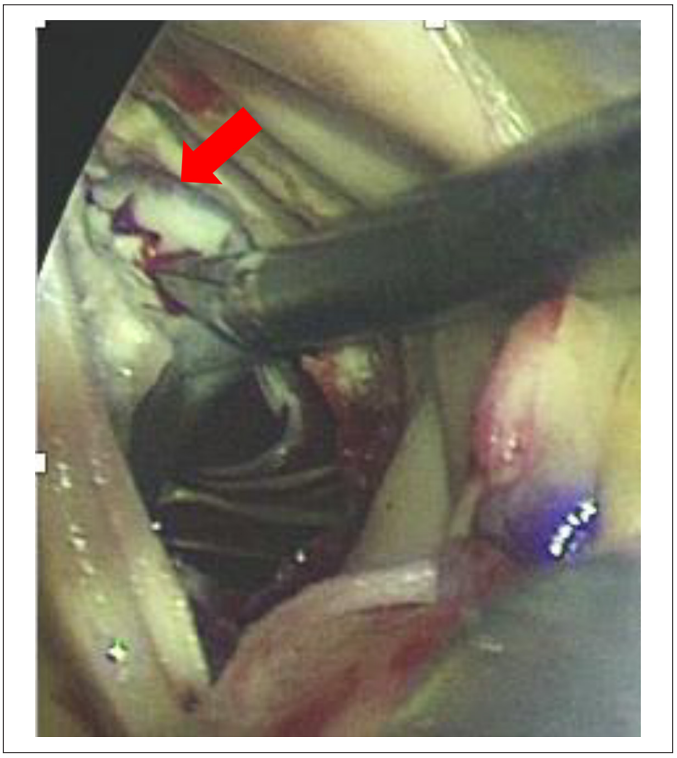

Fig. 2. Thorascopic view of the membranous septal aneurysm (red arrow) during aortic valve replacement surgery.

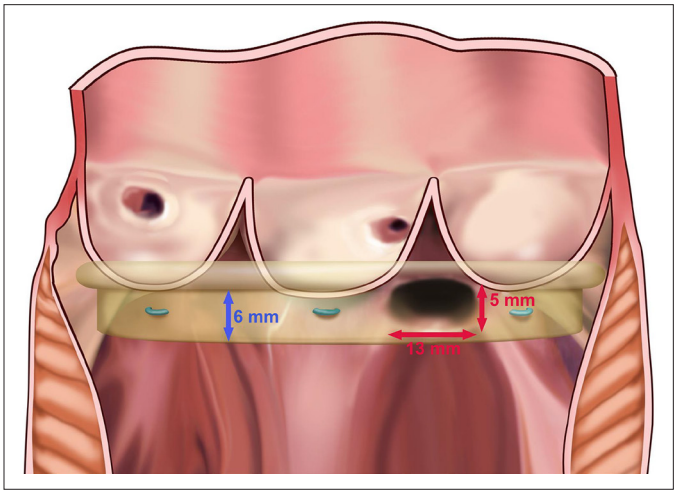

Fig. 3. Membranous ventricular septum aneurysm and Perceval bioprosthesis placement.

prosthesis to the annulus would be difficult because the tissues that normally exist between the right coronary cusp and the noncoronary cusp of the annulus are absent. Moreover, we need to consider the secondary effects of valve replacement, including its effects on the surrounding tissues after valve closure, valve fixation, and aneurysmal rupture. We considered using a Perceval bioprosthesis in this case because it could be placed without sutures in the annulus, and the valve inflow ring may cover the MVSA similar to a surgical patch. For our patient, a detailed anatomical information regarding the annulus and MVSA was obtained by preoperative ECG-CT (Fig. 1a-b). The annulus was measured through CT, obtaining a diameter of 23.7 mm, an area of 425 mm^2 and a peripheral diameter of 74.4 mm. Perceval bioprosthesis cannot be used unless STJ is ≤1.3 times the annulus. The STJ was 27.5 mm in length, and the dimension was less than 1.3 × 23.7 mm. We inferred that Perceval bioprosthesis could be used, and an S-size Perceval bioprosthesis was deemed appropriate. As mentioned, the MVSA was located merely below the commissure between the right coronary and noncoronary cusps. Its diameter was 13 mm × 5 mm, accounting for approximately 18% of the circumference of the aortic annulus at the same height. Considering that the axis of the MVSA orifice was short (5 mm) and the Perceval S-size inflow ring (6 mm in height) could cover the MVSA, placing a Perceval bioprosthesis was considered feasible (Fig. 3). Intraoperatively, the MVSA status was checked by thoracoscopy after the native valve was resected to confirm the stability of the surrounding tissues and to ensure no tissue or structure obstruction in the prosthesis placement (Fig. 2). Intraoperative TEE after bioprosthesis placement revealed no complications, whereas postoperative TEE detected no paravalvular leaks. After the patient was discharged, no problems were detected via TTE; no atrioventricular block occurred, and no further complications were observed.

Moreover, the MVSA was no longer visualized in postoperative ECG-CT (Fig. 1c-d), suggesting that the inflow ring of the Perceval bioprosthesis adequately covered the MVSA. Although patch closure alone is traditionally used for MVSA, the Perceval bioprosthesis has a potential for MVSA treatment, as manifested by our patient.

Conclusions

AVR with Perceval bioprosthesis was an effective treatment strategy for a patient of AS associated with MVSA, resulting in a favorable postoperative course.

Declaration of Conflicting Interests

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Ethics approval

We obtained approval from the review board of Chiba Nishi General Hospital. Informed consent was obtained from the patient before surgery for the publication of this report.

Supplemental Material

Supplemental material for this article is available online.

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