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Case Reports

Early Structural Valve Deterioration and Cusp Tear Leading to Acute Heart Failure in a Second-Generation Trifecta Glide Technology Heart Valve

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Abstract

This report highlights a case of early structural valve deterioration with a cusp tear in a second-generation Abbott Trifecta Glide Technology bioprosthetic heart valve. A 70-year-old man had undergone aortic valve replacement with a Trifecta Glide Technology valve 30 months earlier for severe bicuspid aortic valve stenosis. He suddenly developed acute heart failure with dyspnea resulting from severe aortic valve regurgitation, with a cusp tear in the Trifecta Glide Technology valve, as demonstrated by transthoracic echocardiography. The patient was successfully treated with urgent repeat aortic valve replacement.

Keywords: Aortic valve stenosis; bioprosthesis; heart valve prosthesis implantation

Case Report

Presentation and Physical Examination

A 70-year-old male patient was admitted to the hospital with sudden-onset chest pain, worsening dyspnea, and cough. Physical examination revealed an arterial blood pressure of 123/55 mm Hg, a regular heart rate of 81/min, a respiratory rate of 18/min, a percutaneous oxygen saturation of 93% on room air, a body temperature of 36.5 °C, and no evidence of edema in the extremities. A grade 3 aortic diastolic murmur was heard along the left fourth sternal border, and a grade 1 systolic murmur was heard along the right third sternal border. The patient had a New York Heart Association class IV heart failure (HF), with a cusp tear in the Abbott Trifecta Glide Technology (GT) bioprosthetic heart valve. Written informed consent for publication was obtained from this patient.

Medical History

Thirty months earlier, the patient had undergone aortic valve replacement (AVR) at the same hospital with a 21-mm Trifecta GT valve for severe bicuspid aortic valve stenosis. Recovery from the initial operation was uncomplicated, and the patient had an active, normal life. Routine follow-up transthoracic echocardiography performed 25 months after the initial AVR demonstrated neither periprosthetic nor paraprosthetic leakage, and the mean aortic valve transvalvular gradient was 7 mm Hg.

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Differential Diagnosis

Cardiac auscultation revealed a grade 3 aortic diastolic murmur and a grade 1 systolic murmur. Transesophageal echocardiography revealed severe aortic regurgitation, with a mobile prosthetic leaflet prolapse near the noncoronary cusp (Fig. 1). No vegetation or abscesses were detected, and multiple blood cultures revealed no microorganisms.

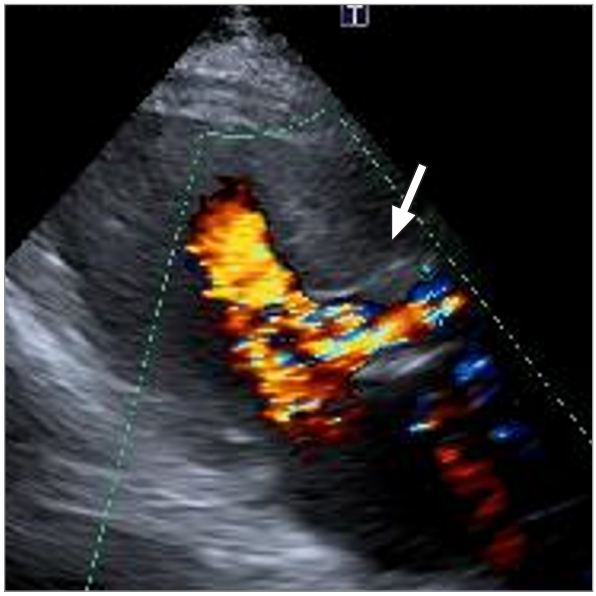

Fig. 1 Preoperative transthoracic echocardiography in a parasternal long-axis view shows severe aortic valve regurgitation (arrow).

Key Points

- Careful and lifelong follow-up, including transthoracic echocardiography, is required for patients who have undergone AVR with a Trifecta GT bioprosthetic heart valve.
- Immediate medical attention is important if new symptoms, such as shortness of breath or fatigue, occur in patients with a Trifecta GT heart valve.
- Prompt redo AVR or valve-in-valve TAVR is required for the management of early SVD with aortic regurgitation in patients with a Trifecta GT heart valve.

Abbreviations

AVR, aortic valve replacement
GT, Glide Technology
HF, heart failure
SVD, structural valve deterioration
TAVR, transcatheter aortic valve replacement

Technique

The heart team decided to perform an urgent repeat AVR. Surgical inspection revealed rupture of the externally mounted pericardial leaflet of the noncoronary cusp extending down to the sewing ring from the top of the stent post (Fig. 2). There were no signs of endocarditis, pannus formation, leaflet calcification, thrombus formation, or paravalvular leakage. The Trifecta GT valve was carefully explanted (Fig. 3), and a 21-mm Inspiris Resilia aortic valve (Edwards Lifesciences) was implanted.

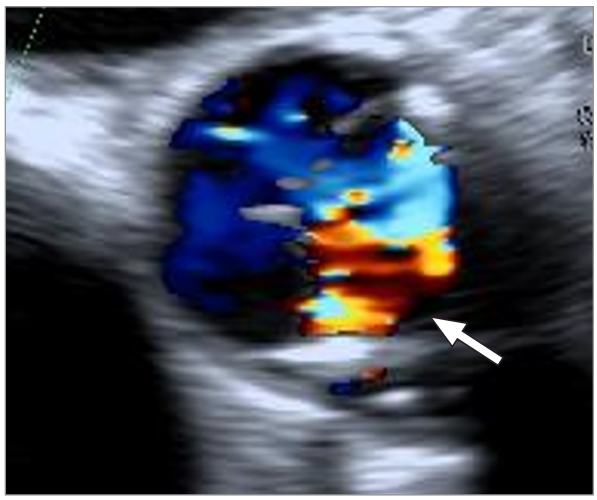

Fig. 2 Preoperative transesophageal echocardiography in a short-axis view shows severe aortic valve regurgitation (arrow).

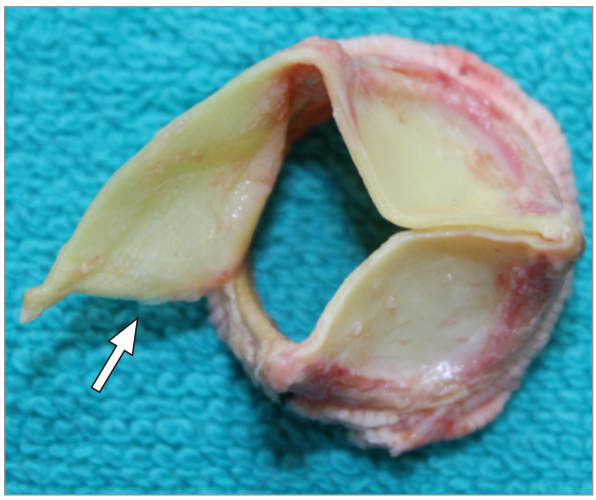

Fig. 3 Photograph shows a pericardial tear of the noncoronary cusp extending from the top of the stent down to the sewing ring (arrow).

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Outcome

Postoperative recovery was uncomplicated, and the patient was discharged on postoperative day 11. The histopathologic examination of the explanted Trifecta GT valve revealed a simple large tear of the pericardial leaflet without infection or calcification. Fibrosis, angiogenesis, and inflammatory infiltrates were not found in the explanted Trifecta GT valve.

Latest Follow-Up

The patient is currently in New York Heart Association class I and has a normal and active daily life.

Discussion

The first-generation Trifecta GT valve, which has been in clinical use since 2011, is an externally mounted bovine pericardial valve that offers hemodynamic advantages over internally mounted valves, such as a larger valve effective orifice area and a lower pressure gradient.[1] Several cases of acute HF due to early structural valve deterioration (SVD) caused by leaflet rupture, however, have been reported as an important problem specific to the Trifecta valve.[1-6] In 2016, the second-generation Trifecta valve with Glide Technology was introduced for commercial use, and several improvements in valve durability were made. The improvements included a newly designed valve holder, a softer sewing cuff, a protective titanium band, and collagen fiber alignment technology. Despite these improvements, however, several cases of early SVD with cusp tears, similar to those in the first-generation Trifecta valve, have been reported with the Trifecta GT valve.[7,8] The authors encountered a case of acute HF with severe aortic valve regurgitation due to early SVD from a cusp tear 30 months after AVR with the Trifecta GT valve, similar to previous reports of SVD with the Trifecta GT valve. Finally, Abbott decided to discontinue first-generation and second-generation Trifecta valve sales after 2023.

The cause of early SVD with the Trifecta GT valve is poorly understood; however, early SVD with similar leaflet tears has been reported with externally mounted bioprosthetic valves since the 1980s.[9-11] Therefore, the specific architecture of the prosthesis, in which the bovine pericardial tissue is mounted externally around the stent and is predisposed to increased mechanical stress and tissue abrasion during leaflet closure, could lead to structural weaknesses and leaflet rupture. Previous investigators evaluated the modes of early Trifecta valve failure in a large population of patients who had undergone reintervention and reported that the cumulative incidence of reintervention for early Trifecta valve failure due to the leaflet tear was 0.16%, 1.08%, and 3.03% at 1, 5, and 9 years, respectively.[12] Furthermore, they found that other mechanisms for early Trifecta valve failure requiring reintervention included diffuse calcification of the prosthetic leaflets without leaflet tear and the presence of pannus formation on the inflow side; however, they concluded that the most common mode of early Trifecta valve failure was the leaflet tear.[12]

In addition, an in vitro experiment comparing the durability of internally mounted (Medtronic Avalus valve and Edwards Lifesciences Magna Ease valve) and externally mounted (Trifecta valve) bovine pericardial leaflets showed that externally mounted leaflets have inferior mechanical durability after 400 million to 600 million test cycles, which is approximately 10 to 15 years.[13] They hypothesized that the failure of the externally mounted leaflet valve was caused by the bioprosthesis' closing mechanism. Although the leaflets of the internally mounted leaflet valve were forced against the other leaflets as they closed, the leaflets of the Trifecta valve wrapped around the stent in each cycle. This repeated leaflet-to-stent contact appears to cause tissue abrasion and ultimately tears the leaflet tissue.

Valve-in-valve transcatheter aortic valve replacement (TAVR) has been reported to be a useful treatment for a failed Trifecta valve[12]; however, the patient in this report had a small Trifecta GT valve (21 mm). Therefore, valve-in-valve TAVR was ruled out for this patient because of the smaller valve area, higher transvalvular gradient, and expected limited durability.

Careful and lifelong follow-up, including transthoracic echocardiography, is required for patients who have undergone AVR with a Trifecta GT valve. Immediate medical attention is important if new symptoms, such as shortness of breath or fatigue, occur. Favorable results have been reported for the treatment of early SVD with aortic valve regurgitation in the Trifecta GT valve with emergent or urgent repeat AVR or valve-in-valve TAVR.[6-8]

In conclusion, a case of acute HF was encountered with severe aortic valve regurgitation owing to early SVD from a cusp tear 30 months after AVR using the Trifecta GT valve. This condition was successfully treated with urgent repeat AVR.

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