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CASE REPORT

INTERMEDIATE

CLINICAL CASE: STRUCTURAL HEART DISEASE

Prosthetic Aortic Valve Regurgitation

The Story of a Missing Piece in the Puzzle

Tanushree Agrawal, MD, Fatima Qamar, MD, MPH, Lakshmi Bindu Chebrolu, MD, Kinan Carlos El-Tallawi, MD

ABSTRACT

A 65-year-old man presented with acute decompensated heart failure. He was found to have severe prosthetic aortic valve regurgitation caused by a fractured strut of a sutureless prosthetic aortic valve that embolized to the distal portion of the aorta. We highlight the importance of multimodality imaging in diagnosis and management. (**Level of Difficulty: Intermediate.**) (J Am Coll Cardiol Case Rep 2022;4:775-779) © 2022 The Authors. Published by Elsevier on behalf of the American College of Cardiology Foundation. This is an open access article under the CC BY-NC-ND license (http://creativecommons.org/licenses/by-nc-nd/4.0/).

HISTORY OF PRESENTATION

A 65-year-old man with a bioprosthetic aortic valve presented with exertional dyspnea (New York Heart Association functional class II) and fatigue of 3 months duration. He was afebrile (temperature: 98 °F [36.6 °C]) and hemodynamically stable (blood pressure: 130/59 mm Hg; heart rate: 79/min). His respiratory rate was 20/min, and his oxygen saturation was 93% on room air. Physical examination was notable for bilateral pulmonary crackles, mild end-expiratory wheezing, an II/IV-intensity early diastolic murmur at the left sternal border, III/VI-intensity ejection systolic murmur at the right upper sternal border, and mild bilateral pitting edema of the ankles. Chest x-ray revealed small bilateral pleural effusions, and bilateral pulmonary interstitial opacities were noted, suggestive of interstitial edema. He was admitted to the hospital for expedited work-up.

LEARNING OBJECTIVES

- To understand the differential diagnosis for prosthetic valve regurgitation.
- To recognize valve strut fracture as a potential complication of prosthetic valves.
- To understand the importance of multimodality imaging in the diagnosis and management of prosthetic aortic valve complications.

PAST MEDICAL HISTORY

Past medical history included hypertension, diabetes mellitus (type 2), chronic obstructive pulmonary disease, and coronary artery disease (prior stent to the left circumflex artery). He was diagnosed with severe aortic stenosis and underwent surgical aortic valve replacement with a bioprosthetic valve 3 years prior. Six months prior, he developed prosthetic valve infective endocarditis with *Staphylococcus lugdunensis* requiring redo aortic valve replacement with a medium-size sutureless bioprosthetic valve. Intraoperative findings then were notable for a large vegetation on the prosthetic aortic valve; however, the tissue culture result was negative. A 4-0 guiding suture was placed at the nadir of each cusp and used to guide the valve down into place, which was then released in the prescribed fashion. There were no difficulties in implantation of the sutureless valve

From the Houston Methodist DeBakey Heart and Vascular Center, Houston, Texas, USA.
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ABBREVIATIONS AND ACRONYMS

CCT = cardiac computed tomography

and no additional manipulation of the prosthesis intraoperatively. After implantation of the sutureless valve, an intraoperative transesophageal echocardiogram revealed that the valve was well seated with a trace of perivalvular leak anteriorly; the perivalvular leak resolved after administration of protamine. Transthoracic echocardiogram on postoperative day 6 showed normal prosthetic valve velocity and gradient (peak velocity: 2.4 m/second; mean gradient: 12 mm Hg; Doppler velocity index: 0.4), with no evidence of aortic regurgitation. Postoperative chest x-ray showed no evidence of prosthetic valve deformation. He completed postoperative antibiotics as prescribed (**Figure 1**).

DIFFERENTIAL DIAGNOSIS

The differential diagnosis included acute decompensated heart failure, prosthetic aortic valve stenosis (pannus, thrombus, or vegetation), and/or prosthetic aortic valve regurgitation (valvular or paravalvular), probably because of a multifactorial etiology, as stated.

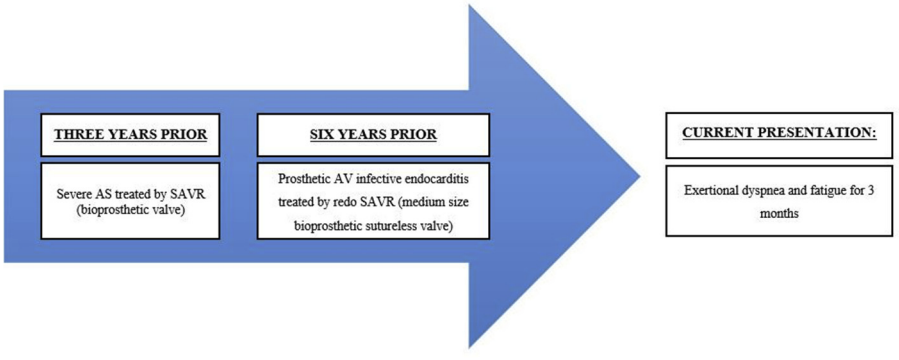
INVESTIGATIONS

B-type natriuretic peptide was elevated at 654 pg/mL. The 12-lead electrocardiogram showed normal sinus rhythm with no significant ST-segment or T-wave changes. Transthoracic echocardiogram was notable for a mildly enlarged left ventricle with preserved systolic function (ejection fraction: 55%-59%), mildly depressed right ventricular systolic function, and significant anterior paravalvular aortic regurgitation (**Figure 2**). Transesophageal echocardiogram showed rocking motion of the bioprosthetic aortic valve posteriorly (Video 1), with significant paravalvular aortic regurgitation encompassing ≥50% of the anterior annular circumference (3 o'clock to 9 o'clock) (**Figure 3**). However, no valvular vegetations were noted. Cardiac computed tomography (CCT) revealed severe valve dehiscence anteriorly. Three-dimensional reconstruction of the valve from the CCT images demonstrated a missing portion of the bioprosthetic aortic valve frame (**Figure 4**). Interrogation of the CCT angiogram revealed the missing piece of valve strut lodged in the proximal right common iliac artery (**Figure 5**). The missing valve portion was 3-dimensionally reconstructed and aligned with the main valve model, suggesting a complete match (Video 2), which ruled out the existence of other embolized pieces.

MANAGEMENT

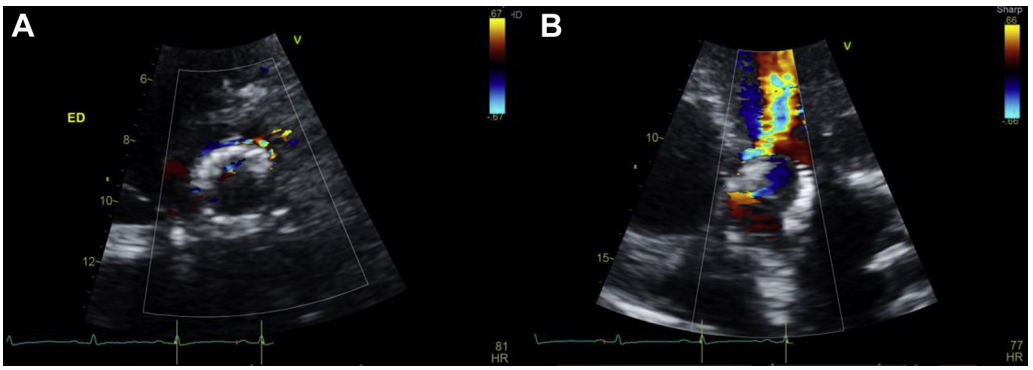
The patient was initiated on intravenous diuretic agents for volume overload. Based on a multidisciplinary team discussion, he was not deemed a candidate for transcatheter valve-in-valve aortic valve replacement because of the recent episode of infective endocarditis. Redo surgical aortic valve replacement was performed using a 25-mm bioprosthetic valve. There were no annular endocarditic lesions reported during surgery. However, after explantation of the initial bioprosthetic valve, a portion of the annulus in the left and noncoronary area required reconstruction with 2 layers of 4-0 sutures because the mitral valve leaflet had become somewhat detached in this area. On postoperative

FIGURE 1 Timeline of the Clinical Presentation



AS = aortic stenosis; AV = aortic valve; SAVR = surgical aortic valve replacement.

FIGURE 2 Transthoracic Echocardiogram



Transthoracic echocardiogram showing an anteriorly located aortic prosthetic paravalvular leak on **(A)** short-axis and apical **(B)** 5-chamber views.

day 5, endovascular retrieval of the fractured valve strut was performed via bilateral femoral artery access.

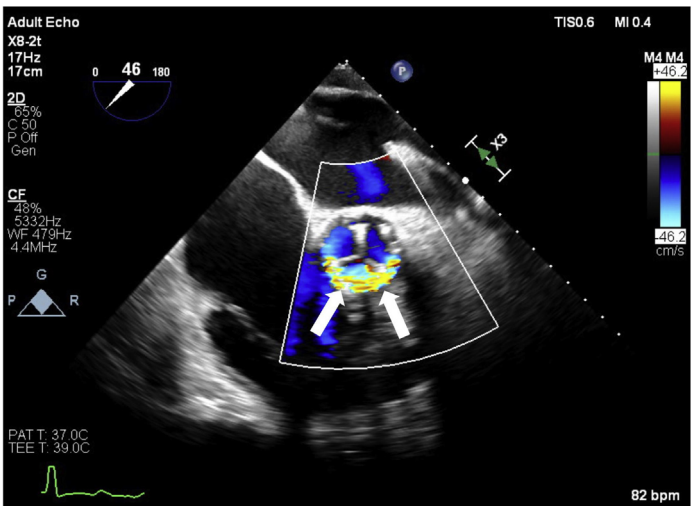
DISCUSSION

Prosthetic valve regurgitation may be either transvalvular or paravalvular. Paravalvular regurgitation is defined as abnormal regurgitant flow caused by an incomplete seal between the native valve annulus and sewing ring of the prosthetic valve. The incidence of paravalvular regurgitation after surgical aortic valve replacement is 2%-10%.[1-3] In the early postoperative course, this is usually attributed to surgical technical factors such as suture techniques, supraannular valve position, and annular calcification. Late paravalvular regurgitation most commonly occurs in the setting of infective endocarditis.[4] The chief clinical manifestations of aortic paravalvular regurgitation are heart failure and hemolytic anemia. Bioprosthetic cardiac valves have limited durability because of progressive structural valve degeneration.[5] This process occurs by leaflet calcification and degradation, which can lead to valve stenosis and/or regurgitation.[6] Structural valve degeneration is fairly uncommon within the first decade after surgical aortic valve replacement (≤15%), but the incidence has been reported to increase thereafter.[6] Fracture of prosthetic valves has been reported with mechanical aortic valve prostheses and after transcatheter pulmonary valve replacement.[7,8] However, to our knowledge, our case represents the first report of fracture of a bioprosthetic surgical valve in the aortic position with strut embolization to the systemic circulation. We believe that the following factors may have led to this phenomenon: undersizing of the sutureless valve, together with underlying endocarditis, may have led to excessive motion of the valve which contributed to nitinol fracture and significant regurgitation.

FOLLOW-UP

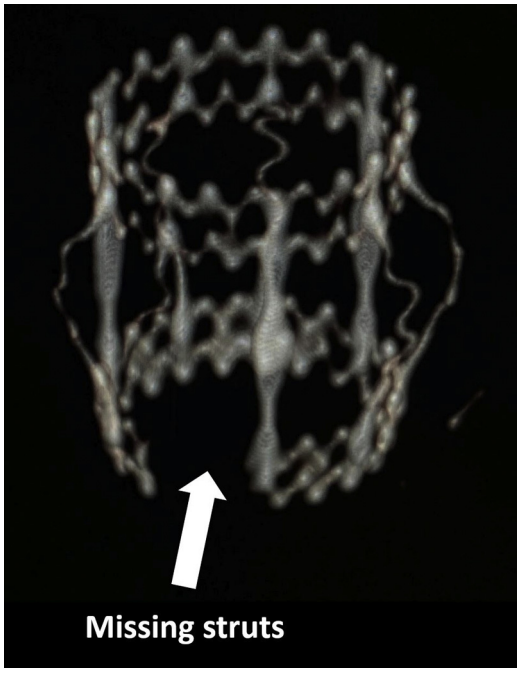
The patient's postoperative course was unremarkable. He was euvolemic at the time of discharge.

FIGURE 3 Transesophageal Echocardiogram



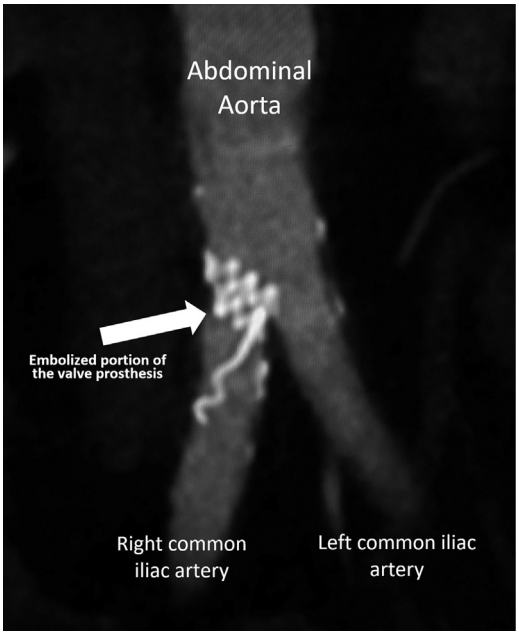
The midesophageal short-axis view with color Doppler depicts the significant extent of the paravalvular aortic regurgitation **(arrows)**.

FIGURE 4 3-Dimensional Valve Reconstruction



3-dimensional valve reconstruction from the cardiac computed tomography acquisition demonstrating the location of the missing valve strut.

FIGURE 5 Cardiac Computed Tomography Angiogram



Cardiac computed tomography angiogram of the infrarenal abdominal aorta showing the missing valve strut lodged in the proximal right common iliac artery.

CONCLUSIONS

This unique case of a broken sutureless valve draws attention to the possibility of leaflet fracture/instability in patients with prosthetic heart valves—a rare complication of a commonly performed procedure. Additionally, it reinforces the importance of comprehensive work-ups involving multiple imaging modalities that can aid in formulating an accurate diagnosis and management.

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The authors have reported that they have no relationships relevant to the contents of this paper to disclose.

ADDRESS FOR CORRESPONDENCE: Dr Kinan Carlos El-Tallawi, Houston Methodist DeBakey Heart and Vascular Center, 6550 Fannin Street, Suite 1801, Houston, Texas 77030, USA. E-mail: keltallawi@houstonmethodist.org.

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KEY WORDS fractured valve, multimodality imaging, prosthetic valve, valve repair

APPENDIX For supplemental videos, please see the online version of this paper.