Incidental identification of an aorto-right ventricular fistula formation years post TAVR

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ABSTRACT

Transcatheter aortic valve replacement (TAVR) is a minimally invasive procedure for treating aortic stenosis. However, it can lead to complications, such as ventricular septal defects (VSD). Although rare, these defects may result in hemodynamic instability and require intervention. An 82-year-old male with a history of Edwards SAPIEN TAVR and heart failure presented with dyspnea, fatigue, and complete heart block. An electrocardiogram showed a heart block, and a transesophageal echocardiogram revealed a mild paravalvular leak and an outlet VSD at the aortic annulus. Cardiac catheterization confirmed a Qp/Qs ratio of 1.68. After pacemaker implantation, the patient remained stable, and conservative management was pursued with outpatient follow-up. Aorto-right ventricular fistula is a rare late complication of TAVR. Clinicians should consider VSD in patients with complete heart block and a TAVR history, and regular echocardiographic surveillance may be warranted for symptomatic patients.

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Introduction

Transcatheter aortic valve replacement (TAVR) is a well-established procedure for treating symptomatic aortic stenosis in patients at high surgical risk. While generally safe, TAVR can result in complications such as conduction abnormalities, paravalvular leaks, and, rarely, ventricular septal defects (VSD). VSD formation, particularly at the aortic annulus, can contribute to hemodynamic changes, heart failure symptoms, or conduction abnormalities, necessitating further intervention. This case highlights the incidental discovery of an aorto-right ventricular fistula years post-TAVR in a patient presenting with complete heart block.[1-3]

Case Report

An 82-year-old male with a history of severe aortic stenosis underwent successful (TAVR) with an Edwards SAPIEN valve five years prior to presentation. The procedure was uncomplicated, with appropriate valve positioning and no immediate post-procedural complications. Post-TAVR surveillance over the following years included routine transthoracic echocardiography, which demonstrated a well-seated bioprosthetic valve with no paravalvular leak or structural abnormalities. The patient was managed with guideline-directed medical therapy for heart failure with preserved ejection fraction (HFpEF) and remained stable, reporting good functional status (NYHA Class I-II) and no hospitalizations for cardiac issues. The patient presented to the emergency department with progressive dyspnea, dizziness, and near-syncope over two weeks. His medical history included hypertension, hyperlipidemia, and chronic kidney disease stage III. Upon arrival, his vital signs showed a heart rate of 38 beats per minute, blood pressure of 112/65 mmHg, and an oxygen saturation of 96% on room air. Physical examination revealed bradycardia, a grade II/VI systolic murmur at the left sternal border, and mild lower extremity edema.

An electrocardiogram (EKG) demonstrated complete heart

block with a ventricular escape rhythm at 35 beats per minute. Laboratory evaluation revealed a mildly elevated brain natriuretic peptide (BNP) level of 220 pg/mL, and the troponin T level was 0.110 ng/L (normal <0.01 ng/L). Transthoracic echocardiography showed a mild paravalvular leak at the 9 o'-clock position (Figure 1), an outlet ventricular septal defect (VSD) at the level of the aortic annulus into the right ventricle (Figure 2), and a preserved left ventricular ejection fraction of 55%. Cardiac catheterization confirmed the presence of left-to-right shunting with a Qp/Qs ratio of 1.68, indicative of a hemodynamically significant shunt.

The patient underwent urgent temporary transvenous pacing, followed by permanent pacemaker implantation on hospital day three. Given the absence of heart failure exacerbation and hemodynamic stability, the decision was made to pursue conservative management with outpatient monitoring. At the three-month follow-up, the patient remained stable without signs of worsening heart failure or recurrent brady-arrhythmias.

Discussion

This case underscores a rare but significant late complication of TAVR: an aorto-right ventricular fistula presenting with complete heart block. The development of this complication five years after an initially successful and uncomplicated TAVR highlights the importance of long-term vigilance. In this specific case, the evolution of the patient's condition is noteworthy. Routine follow-up over the years showed no indication of shunt or paravalvular leak until the time of presentation. The sudden onset of bradyarrhythmia and new murmur raised suspicion for a structural complication, and imaging confirmed the presence of a VSD. The etiology likely involves chronic mechanical stress exerted by the prosthetic valve at the annular level, possibly exacerbated by calcific degeneration or gradual tissue remodeling around the bioprosthesis.[1,2,4-7]

Ventricular septal defect (VSD) following TAVR is rare, and

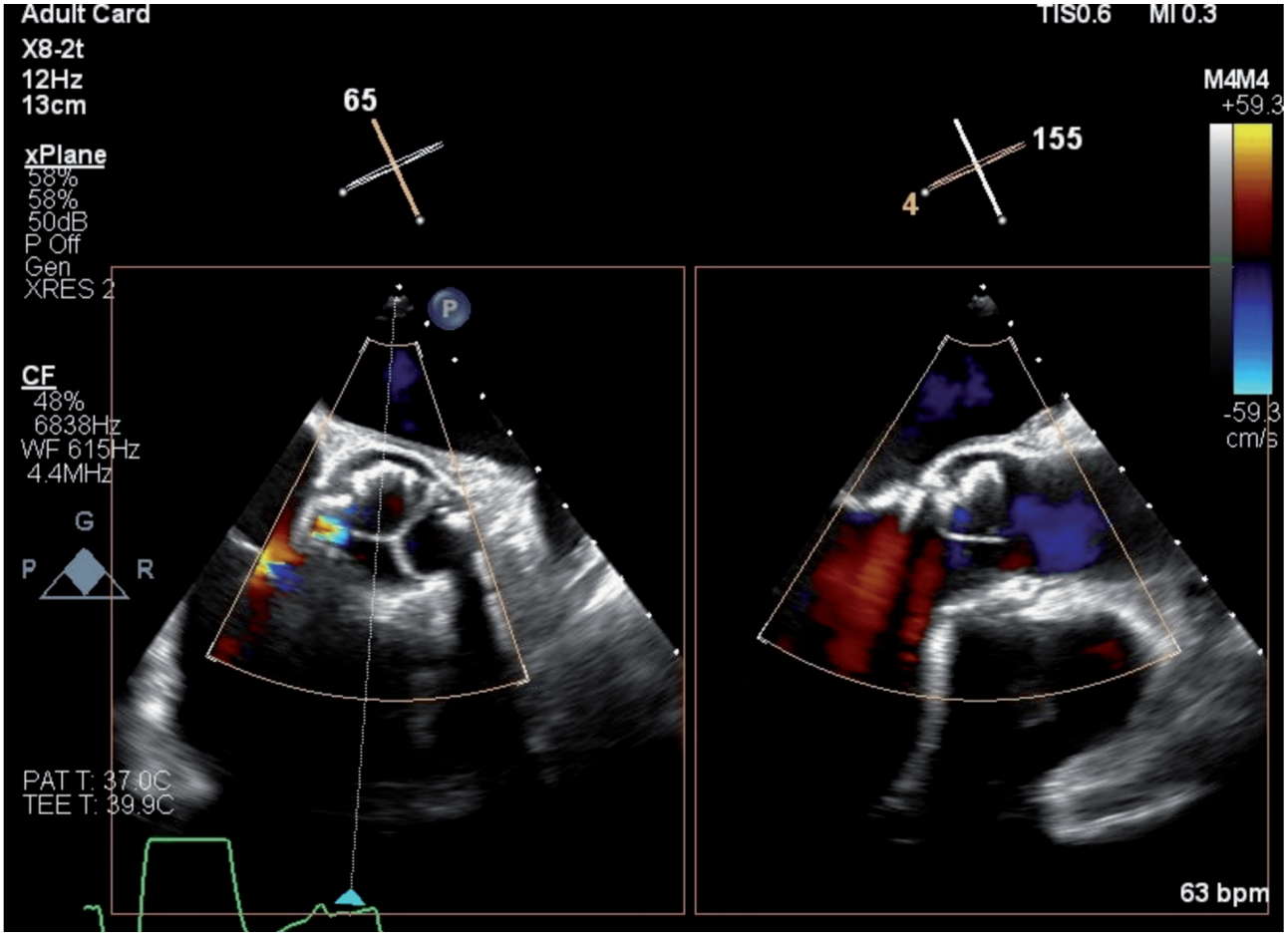

Figure 1. Post-TAVR ventricular septal defect visualized on imaging studies. Biplane transesophageal echocardiography showing a ventricular septal defect. The left panel (~65°) displays a short-axis view with turbulent left-to-right color Doppler flow through the interventricular septum. The right panel (~155°) shows a long-axis view with color Doppler confirming the left-to-right shunt directed toward the right ventricular outflow tract.

proposed mechanisms include excessive radial force from the prosthetic valve, direct trauma during balloon valvuloplasty, or late tissue erosion due to chronic inflammation or calcification. In this patient, the delayed presentation supports a hypothesis of gradual erosion or tissue remodeling, rather than immediate post-procedural trauma. Chronic inflammation and endothelial remodeling may also contribute to delayed presentations of post-TAVR VSD.[1,2,4-8] His lack of previous VSD findings in echocardiograms further supports this hypothesis.

Clinicians should maintain a high index of suspicion for VSD formation following TAVR, particularly in patients presenting with new or worsening dyspnea, the development or intensification of a murmur, signs of heart failure such as fluid overload and lower extremity edema, unexplained bradyarrhythmias or conduction abnormalities, and symptoms suggestive of left-to-right shunting, such as exertional fatigue and dizziness.[2-4,8,11,11-15] Early recognition of these red flags can facilitate timely diagnosis and intervention.

If left untreated, a VSD post-TAVR can lead to several serious complications. Persistent left-to-right shunting increases right ventricular volume overload, leading to pulmonary congestion and progressive heart failure. Chronic VSD may contribute to atrial and ventricular arrhythmias due to chamber dilation and electrical instability. Additionally, increased pulmonary blood flow from left-to-right shunting can elevate pulmonary pressures, leading to secondary pulmonary hypertension. The turbulent blood flow through the septal defect also increases the risk of infective endocarditis, particularly in patients with prosthetic valves. Over time, the defect may enlarge, worsening hemodynamic instability and necessitating more invasive intervention.[2-4,8,11,11-15] Current guidelines from the American Heart Association (AHA), European Society of Cardiology (ESC), and American College of Cardiology (ACC) emphasize the importance of post-TAVR surveillance for structural complications. While routine echocardiographic follow-up is not universally mandated, symptomatic patients should undergo im-

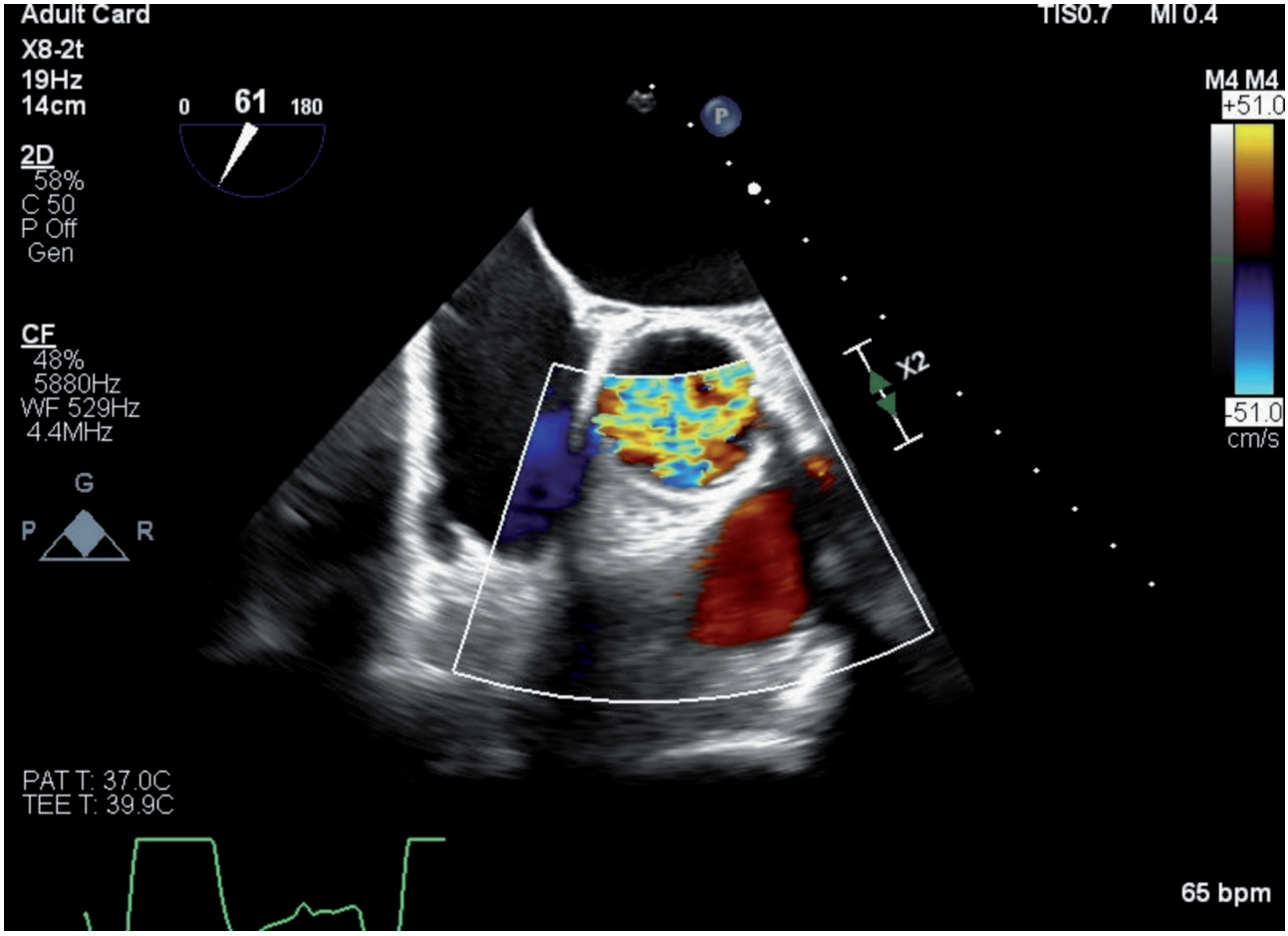

Figure 2. Post-TAVR ventricular septal defect visualized on imaging studies. Transesophageal echocardiogram demonstrating an aorto-right ventricular fistula post-TAVR, a mild paravalvular leak at the 9 o'clock position.

aging to assess for late complications such as fistula formation. Management strategies should be tailored to individual patient stability, with intervention considered in cases of significant left-to-right shunting (Qp/Qs >1.5) or symptomatic deterioration.[16,17]

The diagnosis of VSD post-TAVR requires a high index of suspicion, especially in patients presenting with new-onset murmurs, dyspnea, or conduction abnormalities. Key diagnostic modalities include echocardiography, which can be performed transthoracically (TTE) or transesophageally (TEE) to identify the location of the defect, assess shunt severity, and evaluate associated valvular abnormalities. Cardiac catheterization remains the gold standard for hemodynamic assessment, confirming the presence of left-to-right shunting through oximetry studies and Qp/Qs calculation. Additionally, cardiac MRI provides detailed anatomical characterization of the defect and quantifies shunt volume, offering further insight into the hemodynamic significance of the lesion.[2-4,8,11-14]

Management strategies for post-TAVR VSD depend on the size of the defect, hemodynamic significance, and patient symptoms. Small, hemodynamically insignificant VSDs without heart failure symptoms may be managed conservatively with serial echocardiographic monitoring. For moderate-to-large defects with significant shunting (Qp/Qs >1.5) and symptoms of heart failure, transcatheter device closure is a viable minimally invasive option. In cases of refractory heart failure, large defects, or failed percutaneous intervention, surgical repair remains the definitive treatment.[5,7,15,18] Given the patient's stable condition at the three-month follow-up, with no evidence of worsening heart failure or recurrent bradyarrhythmias, the team opted to continue conservative management and arranged for ongoing outpatient follow-up with the cardiology team.

The primary takeaway from this case is that clinicians should maintain long-term vigilance for structural complications in patients with a history of TAVR, even years after an initially uncomplicated procedure. This case illustrates how a rare aorto-right ventricular fistula can present insidiously with conduction abnormalities like complete heart block, highlighting the importance of considering late-onset ventricular septal defects in the differential diagnosis. Timely recognition using multimodal imaging and individualized management, including conservative approaches when clinically stable, can lead to favorable outcomes.

Conclusions

Aorto-right ventricular fistula is a rare but potentially serious complication that can present years after TAVR implantation. Patients with complete heart block and a history of TAVR should be evaluated for structural complications, including VSD. Further studies are warranted to determine optimal screening and management strategies for these late-presenting complications.

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