JACC: CASE REPORTS VOL. 1, NO. 5, 2019

CASE REPORT

BEGINNER

CLINICAL CASE

Aortic Paravalvular Leak Repair

Can TAVR Be the Answer?

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ABSTRACT

A 71-year-old male with endocarditis mediated severe paravalvular leak and nonischemic cardiomyopathy underwent percutaneous repair attempts with a closure device followed by valve-in-valve transcatheter aortic replacement procedure. The case was complicated by cardiac arrest requiring hemodynamic support with Impella placement and secondary iatrogenic central aortic insufficiency requiring further intervention. (**Level of Difficulty: Beginner.**) (J Am Coll Cardiol Case Rep 2019;1:796–802) © 2019 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 71-year-old Caucasian male with medical history of bicuspid aortic valve and aortic root aneurysm requiring Bentall with a 30-mm Hemashield background graft and surgical aortic valve replacement (AVR) with a Mitroflow 27-mm valve in 2011 (AVR was performed first and sewn into the annulus followed by Bentall which was sewn independently), complete heart block status-post dual-chamber pacemaker in 2014, hypertension, and atrial fibrillation who had recently undergone a dental procedure and was found to be bacteremic post-procedure. The patient underwent workup initially with no echocardiographic evidence of endocarditis and was treated with a long course of antibiotics. On follow-up echocardiography, the patient was found to have new systolic cardiomyopathy with reported left ventricular ejection fraction (LVEF) of 25% to 30% and severe paravalvular leak (PVL) secondary to partial dehiscence of his prior bioprosthetic valve. He was reporting New York Heart Association functional class IV symptoms. The patient was evaluated for surgical repair and not deemed to be a candidate for re-do surgery at an outside facility (formal evaluation and Society of Thoracic Surgery score not available). He was then referred to our facility for percutaneous repair.

INVESTIGATIONS

The patient initially underwent transesophageal echocardiography (TEE) which confirmed a severely reduced LVEF (30%) and dilated cardiomyopathy with severe PVL (**Figure 1**, Videos 1 and 2). The leak was focal due to partial dehiscence of the prior bioprosthetic valve. There was no echocardiographic evidence of endocarditis. The patient then underwent angiography which showed no evidence of obstructive coronary artery disease (**Figures 2 to 4**).

From Kaleida Health, affiliated with the Department of Cardiology, University of Buffalo, Buffalo, New York. Dr. Cimato has received research grants from Bristol-Myers Squibb and NIH but are unrelated to PVL closure devices and TAVR. Dr. Iyer has received personal fees from Proctor Edwards, BSCI, and Medtronic. All other authors have reported that they have no relationships relevant to the contents of this paper to disclose.

Informed consent was obtained for this case.

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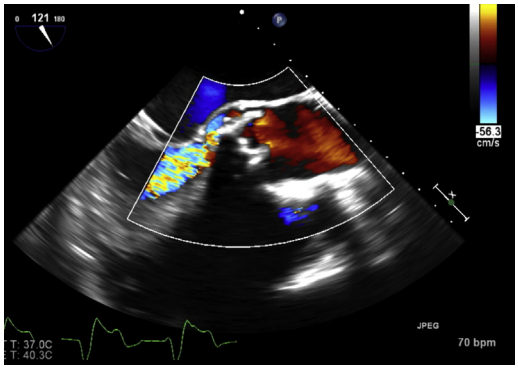
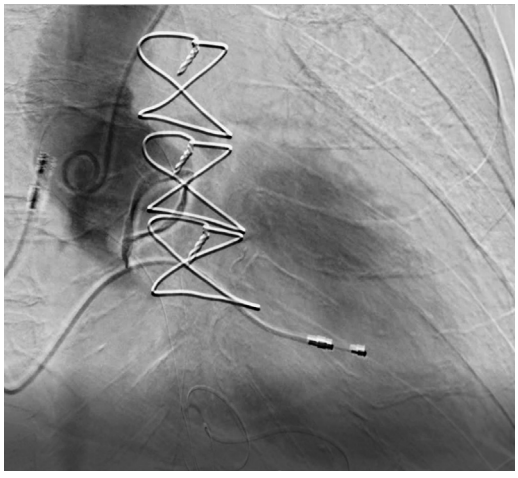
FIGURE 1 Initial Transesophageal Echocardiogram Showing Severe Paravalvular Leak



MANAGEMENT. Percutaneous PVL plugging was attempted with an Amplatzer vascular plug. However, given that this type of bioprosthesis had externally mounted leaflets, attempts at placing the device resulted in bioprosthetic leaflet impingement and valve malfunction (**Figures 5 and 6**). The procedure was aborted, and the patient was later brought to the structural lab with plans for valve-in-valve (ViV) transcatheter aortic valve replacement (TAVR). Fracturing was planned to address the PVL. The patient underwent ViV TAVR with a 26-mm S3 Edwards TAVR valve (Videos 3 and 4) but did not tolerate the procedure and experienced a pulseless electrical activity arrest during fracturing requiring cardiopulmonary resuscitation with eventual return of spontaneous circulation. The patient was placed on veno-arterial extracorporeal membrane oxygenation (VA ECMO). Impella support was added to offload the left ventricle given the degree of cardiomyopathy and hemodynamic compromise and the patient was transferred to the coronary care unit (**Figures 7 to 10**). In the coronary care unit, the patient required minimal inotropic support and mechanical circulatory support was slowly weaned. VA ECMO was decannulated in the operating room the following day and the Impella device was removed in the catheterization lab 2 days after placement. The patient was extubated after being successfully weaned from mechanical circulatory support and was hemodynamically stable and neurologically intact. Repeat echocardiography showed severe aortic insufficiency (AI), but the patient was hemodynamically stable and an attempt at conservative management was planned. He decompensated a few days later with evidence of multiorgan system failure and cardiogenic shock. Repeat TEE showed severe focal PVL which was mildly improved from earlier as well as severe central AI (Videos 5 and 6). The central AI was thought to be due to TAVR leaflet damage either from the Impella device or less likely during the fracturing process (**Figures 11 and 12**). The patient was treated medically and optimized with inotropic support using dobutamine and afterload reduction with hydralazine with significant improvement in shock physiology. His management was again discussed with the cardiothoracic surgery team for a salvage procedure, but he was deemed not to be a surgical candidate because of his medical condition at the time. The patient then underwent successful plugging of the PVL using a ventricular septal defect closure device (Videos 7 and 8) followed by redo valve-in-valve-in-valve (ViViV) TAVR with a 29-mm Core valve with near complete resolution of both paravalvular and central AI (**Figures 12 to 18**, Videos 9, 10, 11). He was extubated the following day and continued to recover and was eventually discharged to a subacute rehabilitation facility. He has since undergone outpatient echocardiography with reported LVEF of 40% and New York Heart Association functional class I to II symptoms reported by his outpatient cardiologist.

FIGURE 2 Aortic Root Angiography Showing Severe Insufficiency



ABBREVIATIONS AND ACRONYMS

AI = aortic insufficiency

AVR = aortic valve replacement

LVEF = left ventricular ejection fraction

PVL = paravalvular leak

TAVR = transcatheter aortic valve replacement

VA ECMO = veno-arterial extracorporeal membrane oxygenation

ViV = valve-in-valve

ViViV = valve-in-valve-in-valve

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FIGURE 3 Left Coronary Artery Angiography

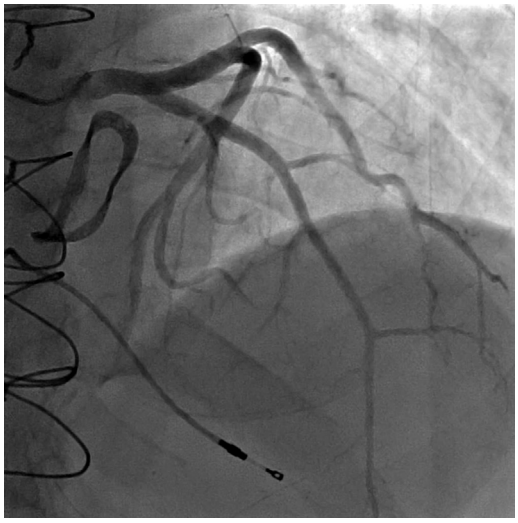
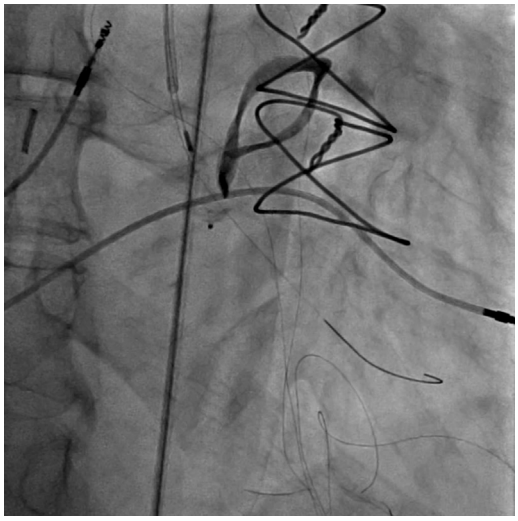


FIGURE 5 Initial Paravalvular Leak Repair Attempt



DISCUSSION

Externally mounted leaflets are a significant obstacle in percutaneous PVL plugging due to the potential for leaflet impingement and valve malfunction (1). If the patient is not a candidate for surgical valve repair/replacement and the PVL is of severe consequence, it may be reasonable to perform TAVR with bioprosthetic valve fracturing to address the PVL or to modify the anatomy so that percutaneous plugging can be performed (2). In this case, the first VIV procedure was performed using a balloon expandable S3 Edwards TAVR valve which was chosen due the patient's relatively young age and the possibility of need for coronary interventions in the future. The redo ViViV was performed with a self-expanding Core valve which was chosen to allow for adequate effective orifice area given there are

FIGURE 4 Right Coronary Artery Angiography

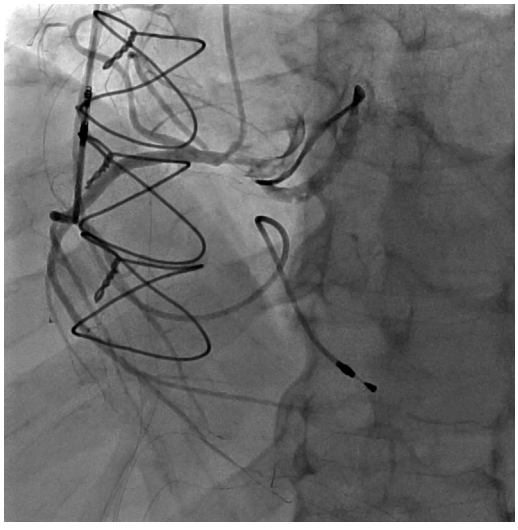


FIGURE 6 Transesophageal Echocardiogram of Initial Paravalvular Leak Repair Attempt

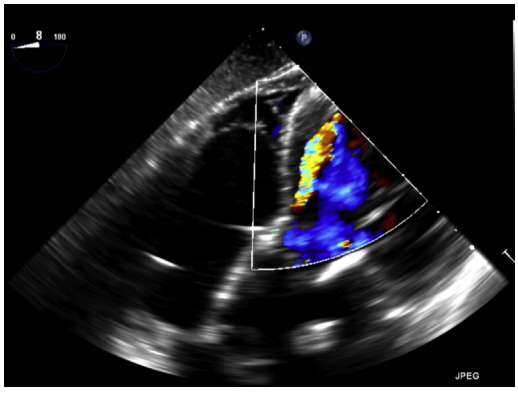
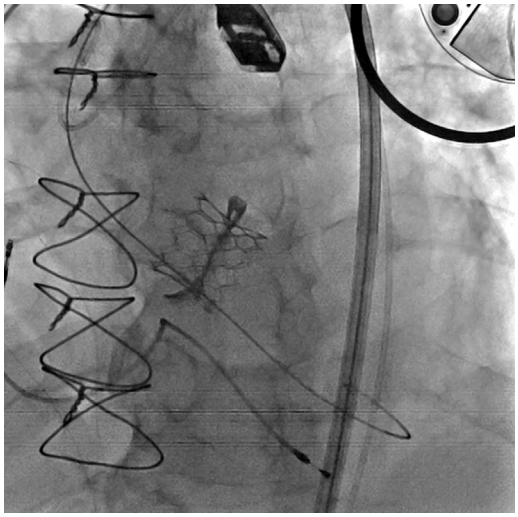


FIGURE 7 Valve-in-Valve Transcatheter Aortic Valve Replacement With 26-mm S3 Edwards Valve



now 3 bioprosthetic valves in the aortic root. The final result was satisfactory with normal gradients (peak/mean gradients of 17/8 mm Hg, respectively) across the valve and normal calculated effective orifice area by continuity equation (2.01 cm^2) with no echocardiographic evidence of patient prosthesis mismatch.

In this case, there was also severe central insufficiency of the S3 Edwards TAVR valve which was present post-procedure. This was believed to be due to leaflet damage secondary to the Impella device and less likely to be related to leaflet damage during fracturing. Angiography after placement of the S3 TAVR valve showed PVL with no evidence of central AI. Because of the

FIGURE 8 Persistent Severe Paravalvular Leak Post Valve-in-Valve Procedure: No Central Aortic Insufficiency

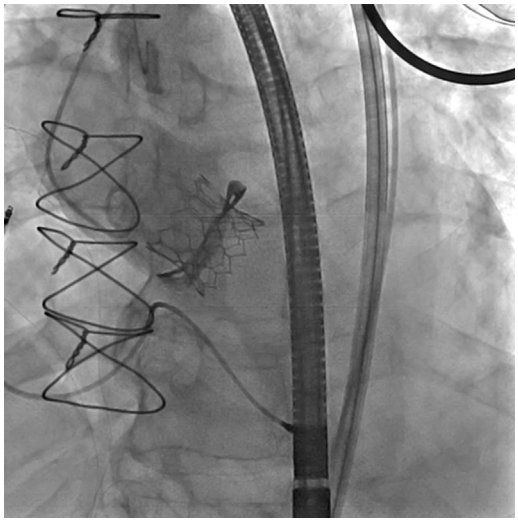


FIGURE 9 Transesophagel Echocardiogram Showing Evidence of Persistent Paravalvular Leak: No Central Aortic Insufficiency

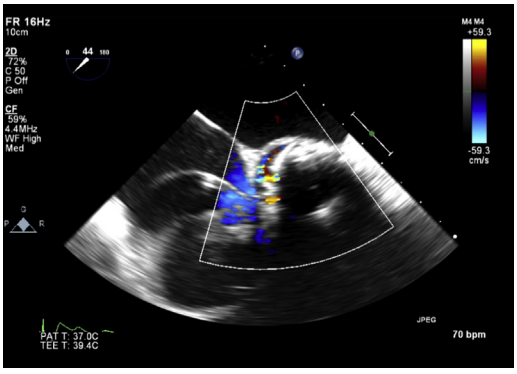


FIGURE 10 Patient Was Placed on Veno-Arterial Extracorporeal Membrane Oxygenation and Impella

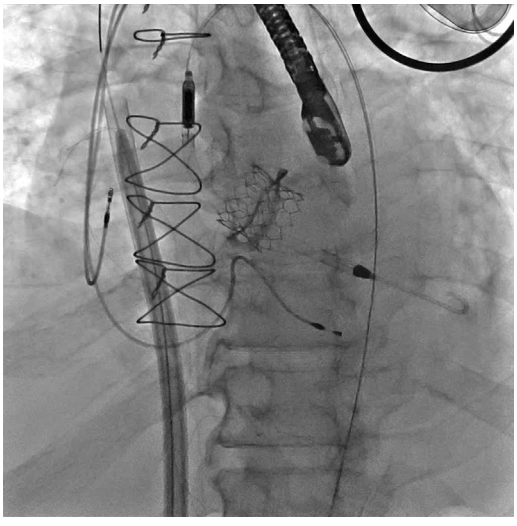


FIGURE 11 Transesophageal Echocardiogram Post Valve-in-Valve Procedure Showing Both Central and Paravalvular Aortic Insufficiency

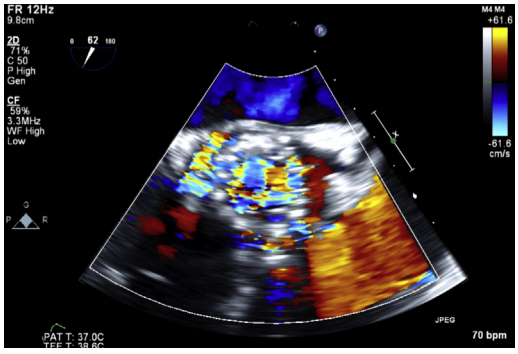
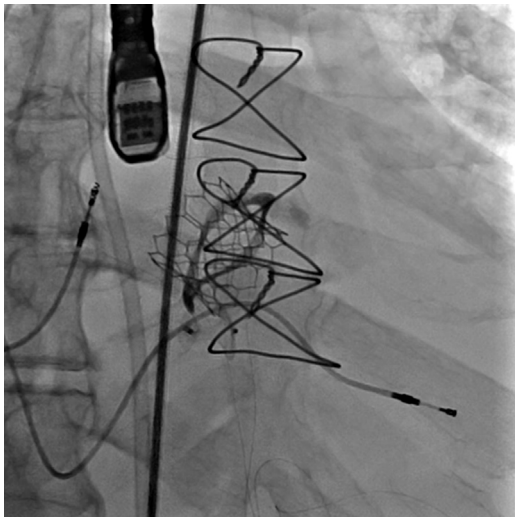


FIGURE 13 Status Post-Placement of Paravalvular Leak Closure Device



significant echocardiographic color mosaic caused by the Impella device and despite the patient having had multiple transthoracic echocardiograms with the Impella in place, it is not possible to adequately determine if the central insufficiency was present shortly after the Impella placement, or if the valve leaflet damage happened during removal of the Impella device. In this case, the Impella device was removed in the catheterization lab in a controlled setting with adequate hemostasis, but due to the patient's renal dysfunction, aortic root angiography was not performed at the time; therefore, it is not possible to determine if the valve leaflet damage occurred during the removal procedure. Iatrogenic AI secondary to Impella device placement is rare but has been reported and may have been a confounding factor in our patient's case (3). The need for a third valve was entirely dependent on the presence of central AI and without it; PVL plugging could have been performed without the need for a third valve.

FIGURE 12 3-Dimensional Transesophageal Echocardiogram Showing Valve Leaflet Flail as Well as Paravalvular Space

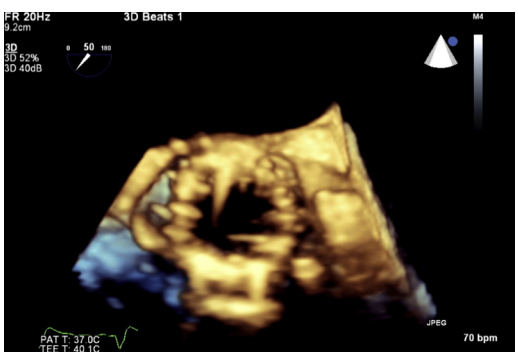


FIGURE 14 Near Complete Resolution of Paravalvular Leak With Residual Central Valvular Insufficiency

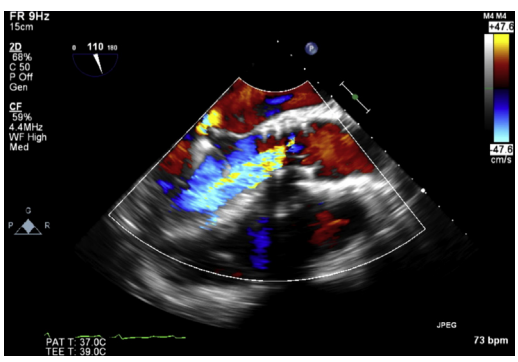


FIGURE 15 Valve-in-Valve-in-Valve Placement of 29-mm Core Valve

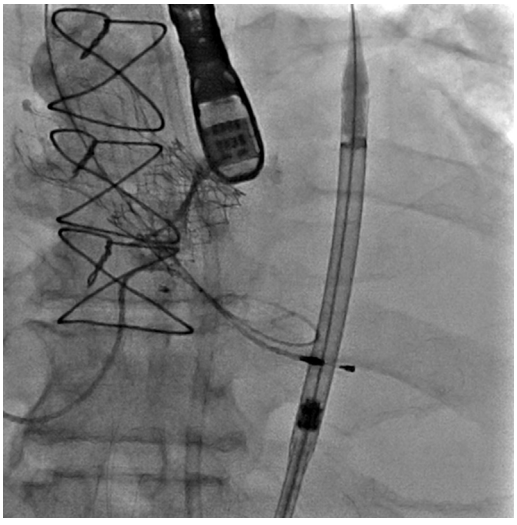
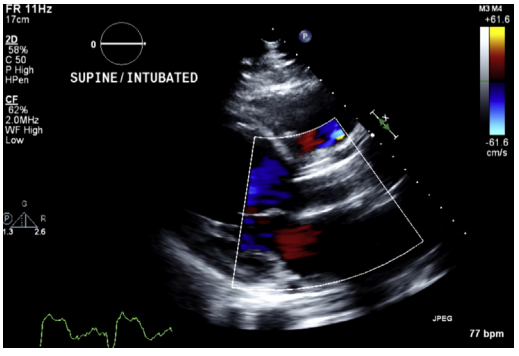


FIGURE 17 Post-Procedure Transthoracic Echocardiogram Showing Trace to No Aortic Central or Paravalvular Insufficiency



CONCLUSIONS

PVL remains challenging in the world of percutaneous structural heart interventions (4). There is a large variety of surgical prosthetic valves with different leaflet designs that mandate individualization of the procedure to the different valve types. TAVR can be used as a backup option with fracturing of the TAVR valve as a viable option for addressing PVLs. Alternatively, PVLs can be addressed percutaneously followed by placement of a TAVR valve if leaflet impingement cannot be avoided. The use of Impella devices can result in iatrogenic central insufficiency and risks and benefits should be carefully considered on a case-by-case basis. Finally, mechanical circulatory support both in the form of ECMO and Impella devices can afford the patient and the interventional cardiologist the time needed to address complications while minimizing anoxic brain injury and end-organ dysfunction.

FIGURE 16 Transesophageal Echocardiogram Showing Near Complete Resolution of Both Central and Paravalvular Insufficiency

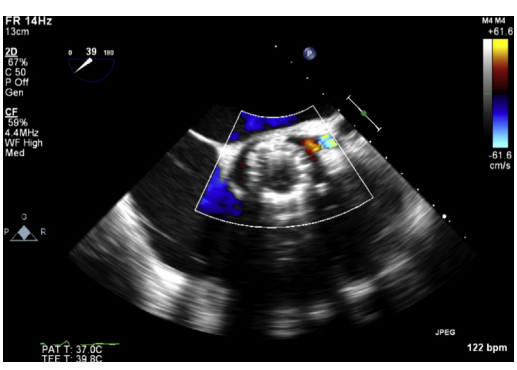
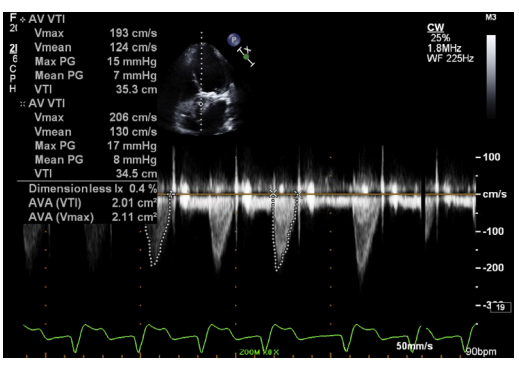


FIGURE 18 Continuous-Wave Doppler Showing Normal Transcatheter Aortic Valve Replacement Valve Velocities and Gradients and No Insufficiency Spectral Doppler Signal Confirming Lack of Any Significant Central or Paravalvular Insufficiency



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KEY WORDS aortic valve, valve repair, valve replacement

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