JACC: CASE REPORTS VOL. 3, NO. 4, 2021

MINI-FOCUS ISSUE: VALVULAR HEART DISEASE

INTERMEDIATE

CASE REPORT: CLINICAL CASE

Intracardiac Echocardiography to Diagnose Bioprosthetic Pulmonary Valve Thrombosis

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ABSTRACT

A 48-year-old woman presented with heart failure and bioprosthetic pulmonary valve regurgitation 2 years after pulmonary valve replacement. Intracardiac echocardiography demonstrated uniform thickening of a single prosthetic valve leaflet suggesting leaflet thrombosis rather than bioprosthetic valve degeneration. After 3 months of anticoagulation, valve regurgitation and symptoms improved. (**Level of Difficulty: Intermediate.**) (J Am Coll Cardiol Case Rep 2021;3:682–5) © 2021 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 48-year-old woman with tetralogy of Fallot, status post definitive surgical repair in childhood, presented with new symptoms of heart failure 2 years after surgical bioprosthetic pulmonic valve replacement. Her exertional capacity was consistent with New York Heart Association functional class II status, whereas previously she had been asymptomatic. Vital signs were significant for blood pressure of 131/78 mm Hg, heart rate of 65 beats/min, respiratory rate of 18 breaths/min, and oxygen saturation as measured by pulse oximetry of 94%. On physical examination, she had a grade 2 diastolic murmur loudest at the left upper sternal border. A transthoracic echocardiogram demonstrated severe pulmonary valve regurgitation with moderate stenosis (peak transvalvular gradient of 35 mm Hg) and normal left ventricular systolic function. The right ventricle was mildly enlarged with moderately reduced systolic function.

LEARNING OBJECTIVES

- To recognize the role ICE can play in the evaluation of the pulmonary valve, in particular, after pulmonary valve replacement in adult congenital heart disease.
- To differentiate bioprosthetic valve thrombosis from bioprosthetic valve degeneration.

PAST MEDICAL HISTORY

The patient has a history of complex congenital heart disease with tetralogy of Fallot. At the age of 7 years old, she underwent a patch repair of a ventricular septal defect and an atrial septal defect, and resection of infundibular stenosis. Her post-operative course was uncomplicated and she was asymptomatic for almost 20 years. At the age of 26 years, she underwent percutaneous pulmonary balloon valvuloplasty for severe pulmonic stenosis, with improvement of symptoms and transvalvular gradient.

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The authors attest they are in compliance with human studies committees and animal welfare regulations of the authors' institutions and Food and Drug Administration guidelines, including patient consent where appropriate. For more information, visit the Author Center.

Manuscript received December 22, 2020; revised manuscript received February 23, 2021, accepted February 26, 2021.

ISSN 2666-0849 https://doi.org/10.1016/j.jaccas.2021.02.025

At 45 years of age, she presented with symptoms of heart failure. An echocardiogram demonstrated moderate to severe pulmonary valve stenosis with severe pulmonary valve regurgitation. Her right ventricular outflow tract and main pulmonary artery were unsuitable for a transcatheter valve replacement, so she underwent surgical pulmonary valve replacement with a 23-mm Magna (Edwards Lifesciences, Irvine, California) bioprosthetic valve. She also had pericardial patch enlargement of the right ventricular outflow tract of the main pulmonary artery.

DIFFERENTIAL DIAGNOSIS

The differential diagnosis for bioprosthetic pulmonary valve regurgitation 2 years after implantation includes bioprosthetic valve thrombosis, endocarditis, bioprosthetic valve degeneration, paravalvular leak, and valve dehiscence.

INVESTIGATIONS

A 64-slice 4-dimensional computed tomography with contrast was performed to assess for thrombus or vegetation, but none were identified (**Figures 1 and 2**). She also had no leukocytosis, fever, or systemic symptoms suggesting valve endocarditis. Although a reasonable next step in management would be to obtain a transesophageal echocardiogram (TEE) to evaluate the pulmonary valve leaflets, our institutional preference is to favor intracardiac echocardiography (ICE) imaging over TEE, because there are some limitations of TEE in the pulmonic position. A right and left heart catheterization was performed in addition to the bioprosthetic pulmonary valve being directly imaged with a ViewFlex ICE catheter (Abbott Vascular, Chicago, Illinois) (**Figure 3,** Video 1). ICE confirmed severe pulmonary valve insufficiency with no paravalvular leak or valve dehiscence. Importantly, there was also diffuse, uniform thickening of a single bioprosthetic valve leaflet and no evidence of prosthetic leaflet calcification (**Figure 4,** Video 2).

MANAGEMENT

Following her pulmonic valve replacement surgery, the patient had independently discontinued the recommended daily aspirin. After the ICE was performed, aspirin (81 mg daily) was resumed and anticoagulation with apixaban (5 mg twice daily) was initiated to treat presumptive bioprosthetic valve leaflet thrombosis.

Approximately 3 months after the initiation of anticoagulation, a repeat transthoracic echocardiogram demonstrated improvement in pulmonary valve regurgitation from severe to moderate, with a slight improvement in the peak transvalvular gradient from 35 to 27 mm Hg. Her symptoms improved from New York Heart Association functional class II to class I status (asymptomatic). Given the continued moderate pulmonary insufficiency, repeat ICE imaging was considered but deferred given the invasive nature of the procedure and overall clinical improvement of the patient.

ABBREVIATIONS AND ACRONYMS

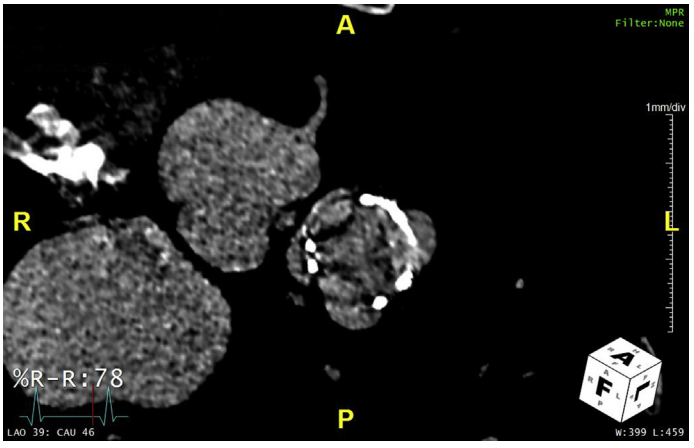
ICE = intracardiac echocardiography

TEE = transesophageal echocardiogram

DISCUSSION

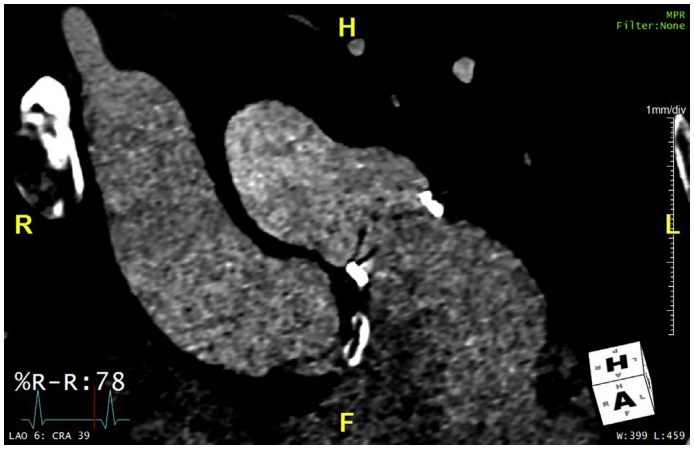
Echocardiographic imaging of the pulmonary valve is notoriously difficult because of its anterior and superior location (1,2). Specifically, transthoracic echocardiographic imaging of the pulmonary valve has been studied after transcatheter pulmonary valve replacement with the Melody Valve (Medtronic Inc.,

FIGURE 1 Computed Tomography Diastolic Short-Axis Images



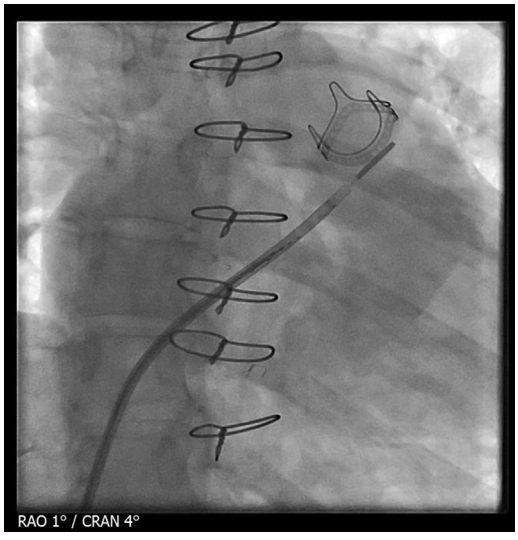
Computed tomography diastolic short-axis images acquired at 78% RR interval, with the window level set to visualize leaflets and thrombus, showing the bioprosthetic valve with no evidence of associated thrombus or pannus.

FIGURE 2 Computed Tomography Diastolic Long-Axis Images



Computed tomography diastolic long-axis images acquired at 78% RR interval, with the window level set to visualize leaflets and thrombus, showing the bioprosthetic valve with no evidence of associated thrombus or pannus.

FIGURE 3 Fluoroscopy Imaging



Fluoroscopy imaging shows the proximity of intracardiac echocardiography catheter to the pulmonary valve allowing for excellent images.

Minneapolis, Minnesota) and demonstrated only modest correlation with pulmonary regurgitant fraction as measured by cardiac magnetic resonance imaging (3). TEE in patients with a prosthetic pulmonary valve is not always beneficial to assess severity of pulmonary insufficiency because visualization of the right ventricular outflow tract and pulmonary prosthesis is limited (1). In particular, imaging of the bioprosthetic leaflets is especially challenging.

Because of these limitations, other imaging modalities are needed to evaluate the pulmonary valve. ICE has an emerging role in the imaging of cardiac structures, both for diagnosis and procedural guidance, particularly in the field of structural heart interventions. ICE has been used for left atrial appendage closure (4), transcatheter mitral valve repair (5), and transcatheter pulmonary valve implantation (6). ICE plays a particularly important role in the diagnosis of pulmonary valve endocarditis, because direct visualization of prosthetic valve leaflets is otherwise challenging (7,8). ICE does have some limitations including the risk for vascular injury, arrhythmias, and currently available catheters only allow for single plane imaging with limited penetration. Advanced ICE catheters offering 3-dimensional imaging and higher spatial resolution are in the late stages of development, but are not currently clinically available.

Gated computed tomography imaging is a useful diagnostic modality in identifying thrombus on valves even at a subclinical level specifically in patients after transcatheter aortic valve replacement (9). In this case, a gated computed tomography scan did not identify thrombus or vegetation, whereas ICE demonstrated the thickening of the bioprosthetic valve leaflet. After a course of anticoagulation, ICE was not performed in order to avoid an additional invasive procedure. Although there was no ICE confirmation of resolution of the thickening on the valve leaflet, it can be deduced that leaflet thrombosis was the etiology of the patient's bioprosthetic valve dysfunction given the improvement in patient's symptoms and valve function following anticoagulation. This patient has been continued on anticoagulation because the exact duration of treatment for bioprosthetic valve thrombosis is unclear (10).

FOLLOW-UP

Oral anticoagulation will be continued for at least 1 year, with repeat transthoracic imaging planned in 6 months.

CONCLUSIONS

ICE imaging is a useful tool for direct imaging of a bioprosthetic pulmonary valve to differentiate among etiologies of pulmonary valve dysfunction.

FUNDING SUPPORT AND AUTHOR DISCLOSURES

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

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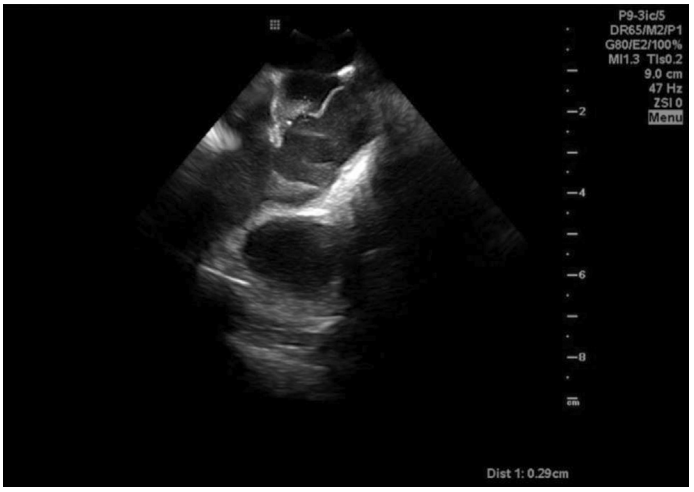
FIGURE 4 Intracardiac Echocardiography Image



Intracardiac echocardiography image of the pulmonary valve with thrombus measurement.

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KEY WORDS echocardiography, pulmonic valve, tetralogy of Fallot

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