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CORONARY, PERIPHERAL, AND STRUCTURAL INTERVENTIONS

CLINICAL CASE

Transcatheter Repair of Acute Torrential Tricuspid Regurgitation Presenting as Platypnea-Orthodeoxia Syndrome



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ABSTRACT

An 82-year-old man developed acute breathlessness and cyanosis, exacerbated while upright and improved on lying flat (platypnea-orthodeoxia syndrome). Echocardiography revealed acute torrential tricuspid regurgitation due to a flail posterior leaflet leading to right-to-left shunting through a patent foramen ovale (PFO). The patient's symptoms resolved after transcatheter PFO closure and tricuspid valve edge-to-edge repair. (JACC Case Rep. 2025;30:102999) © 2025 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

An 82-year-old man presented to hospital with acute breathlessness and cyanosis. The symptoms suddenly developed during a light morning walk; he was unable to continue walking and laid on the ground until the arrival of paramedics. He remained fully conscious and denied chest pain, palpitations, dizziness, presyncope, or syncope. He reported no recent orthopnea, exertional breathlessness, change

in exercise tolerance, infective symptoms or weight loss.

On arrival to hospital, he was breathless and cyanotic with oxygen saturations of 82% on 15 L/min of oxygen in the supine position. Breathlessness and oxygen saturations deteriorated while sitting up in bed (75% on 15 L/min O₂), and he was unable to stand up (desaturating to 67% on 15 L/min O₂). He was tachypneic (24 breaths/min), normotensive (127/78 mm Hg) with a normal heart rate (80 beats/min), and afebrile. Physical examination revealed cold peripheries, raised jugular venous pressure, no audible heart murmurs, normal respiratory sounds, and no peripheral edema.

TAKE-HOME MESSAGES

- POS manifests as positional dyspnea (platypnea) and arterial desaturation in the upright position (orthodeoxia) that improves in the recumbent position.
- Intracardiac right-to-left shunts are a common cause of POS.

PAST MEDICAL HISTORY

The patient had undergone concomitant aortic valve repair and root replacement (28-mm Gelweave interposition graft, Terumo Aortic) 9 years before the

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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](#).

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**ABBREVIATIONS
AND ACRONYMS****POS** = platypnea-orthodeoxia syndrome**PFO** = patent foramen ovale**RV** = right ventricle/ventricular**TR** = tricuspid regurgitation**TTE** = transthoracic echocardiogram

current presentation due to severe symptomatic aortic regurgitation and a dilated aortic root (52 mm at the sinus of Valsalva). He had a diagnosis of early Parkinson's disease. He was an ex-smoker (15 pack-year history). His regular medications consisted of aspirin 75 mg daily, co-careldopa 25 mg/100 mg 4 times daily, and omeprazole 20 mg daily.

INVESTIGATIONS

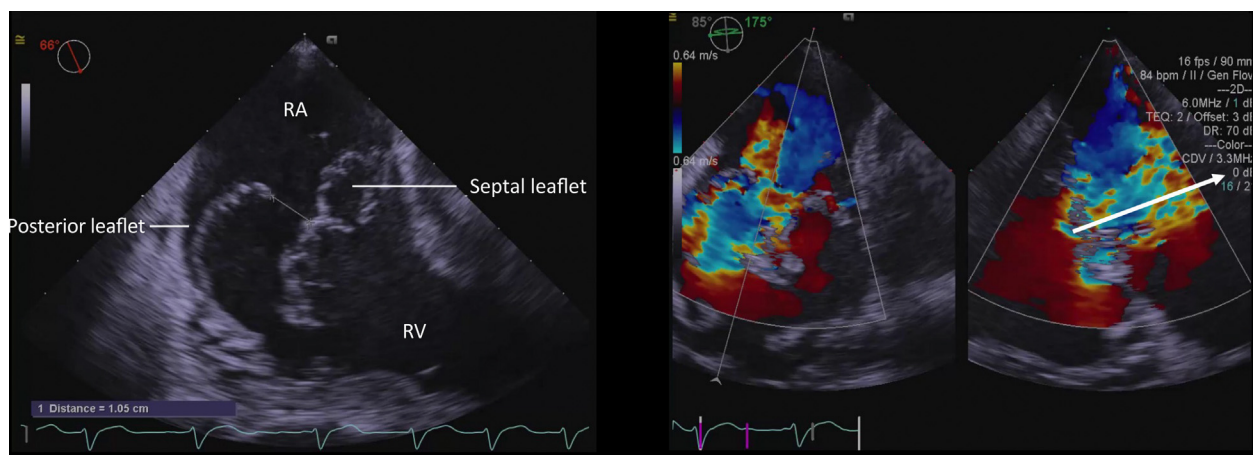
Admission laboratory tests showed a normal hemoglobin, hematocrit, electrolytes, renal function, inflammatory markers, and troponin. Electrocardiogram showed sinus rhythm (80 beats/min), left axis deviation (QRS axis -83°), and right bundle branch block (QRS duration 170 ms, unchanged from previous records). Computed tomography pulmonary angiography was negative for a pulmonary embolism, with normal appearance of the lung parenchyma.

Transthoracic echocardiogram (TTE) revealed torrential tricuspid regurgitation (TR). Left ventricular size and function were normal. His right ventricle (RV) was normal in size with hyperdynamic systolic function. Right atrial size was mildly dilated. Given these findings, in addition to

normal main pulmonary artery diameter on computed tomography pulmonary angiography (30 mm), significant pulmonary hypertension was considered unlikely and right heart catheterization was not performed. Bubble echocardiography demonstrated a significant number of agitated saline bubbles (>20) in the left atrium and the left ventricle within 3 cardiac cycles from right heart opacification, suggestive of a large right-to-left shunt. Transesophageal echocardiography revealed a flail posterior tricuspid leaflet (**Figure 1, Video 1**) with torrential TR passing through the posteroseptal part of the valve, directed toward the interatrial septum. Taken together, these findings suggest acute torrential TR due to degenerative flail of the posterior tricuspid valve leaflet.

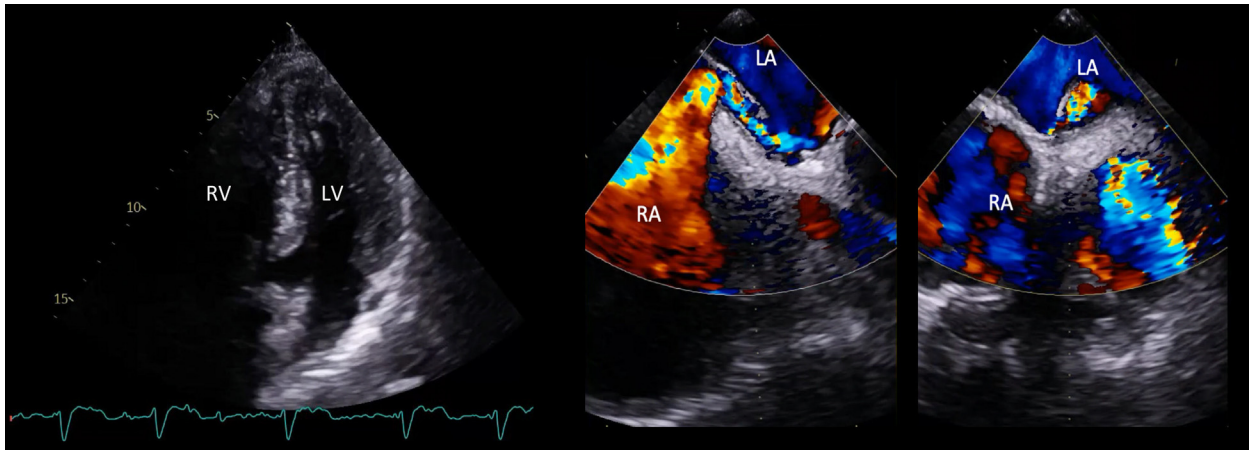
MANAGEMENT

Given the patient's frailty and the degree of hypoxia associated with very high surgical risks, a plan was made to perform transcatheter patent foramen ovale (PFO) closure and tricuspid valve edge-to-edge repair under general anesthesia. Injection of agitated saline from the right femoral vein confirmed significant right-to-left shunt across a PFO (**Figure 2, Videos 2 and 3**). The PFO was successfully closed with a 25-mm Gore Cardioform

FIGURE 1 Tricuspid Valve Posterior Leaflet Flail

Tricuspid valve posterior leaflet flail (left) leading to severe tricuspid regurgitation (TR) (right). The white arrow (right) illustrates the direction of the predominant jet (transesophageal echocardiogram). RA = right atrium; RV = right ventricle.

FIGURE 2 Bubble Study Demonstrating the Presence of a Right-to-Left Shunt



Bubble study (transthoracic echocardiography) demonstrating the presence of a right-to-left shunt (left). Flow across interatrial septum (right) on transesophageal imaging. LA = left atrium; LV = left ventricle; other abbreviations as in [Figure 1](#).

Septal Occluder device (Gore Medical) ([Figure 3](#)), resulting in rapid normalization of his arterial oxygen saturations. Torrential TR was successfully treated by transcatheter edge-to-edge repair with 2 PASCAL Ace devices (Edwards Lifesciences), deployed between the posterior and the septal leaflets ([Figure 4](#), [Videos 4 to 6](#)). The patient made

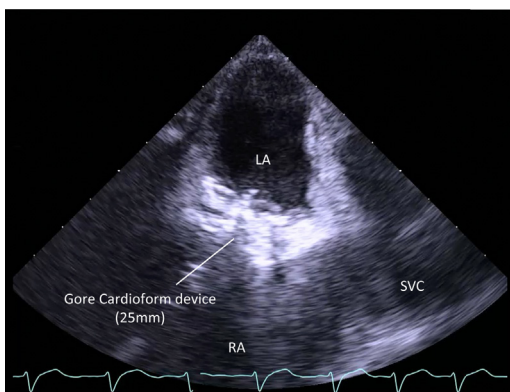
an uneventful recovery, and TTE 24 hours following the procedure revealed stable device position with moderate TR ([Figure 5A](#), [Video 7](#)). He was discharged home the following day.

DISCUSSION

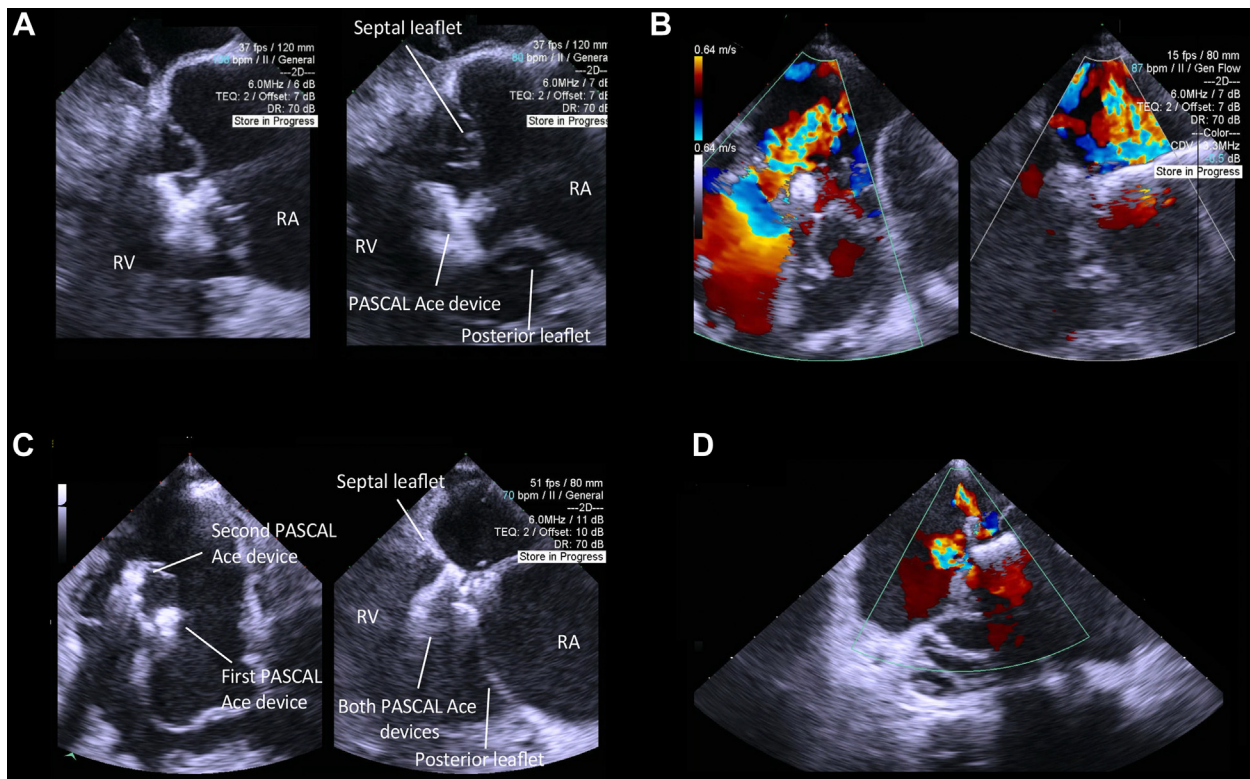
Platypnea-orthodeoxia syndrome (POS) manifests as positional dyspnea (platypnea) and arterial desaturation in the upright position (orthodeoxia) that improves in the recumbent position.¹ This rare clinical presentation ranges from extreme breathlessness to subtle symptoms often requiring a high index of suspicion. Although extra-cardiac causes exist, most presentations are secondary to intra-cardiac right-to-left shunts across the interatrial septum (PFO and/or atrial septal defect).¹ Upright posture stretches the interatrial septum, enlarging the defect and exacerbating the shunt. Additionally, ascending aortic dilation increases aortic arch curvature, compressing the right atrium and facilitating PFO.² Our patient's sinus of Valsalva diameter of 44 mm (TTE, parasternal long axis) confirmed aortic root dilation.

The acute presentation, along with a flail tricuspid valve leaflet, normal RV annular size, hyperdynamic RV function, and only mild right atrium dilatation, suggest acute TR. Tricuspid valve chord rupture typically arises from infective

FIGURE 3 Percutaneous Closure of PFO



Percutaneous closure of patent foramen ovale (PFO) using a Gore Cardioform Septal Occluder 25-mm implant. SVC = superior vena cava; other abbreviations as in [Figure 1](#).

FIGURE 4 TEER of Torrential TR

Transcatheter edge-to-edge repair (TEER) of torrential tricuspid regurgitation (TR). (A) Implantation of the first PASCAL Ace device between the posterior and the septal leaflets (transesophageal echocardiogram [TEE]). (B) Severe residual TR after first device implantation (TEE). (C) Implantation of the second PASCAL Ace device between the septal and the posterior tricuspid valve leaflets, posterior to the first device (TEE). (D) Two jets of moderate residual TR after 2 TEER device implants (TEE). Abbreviations as in [Figures 1 and 2](#).

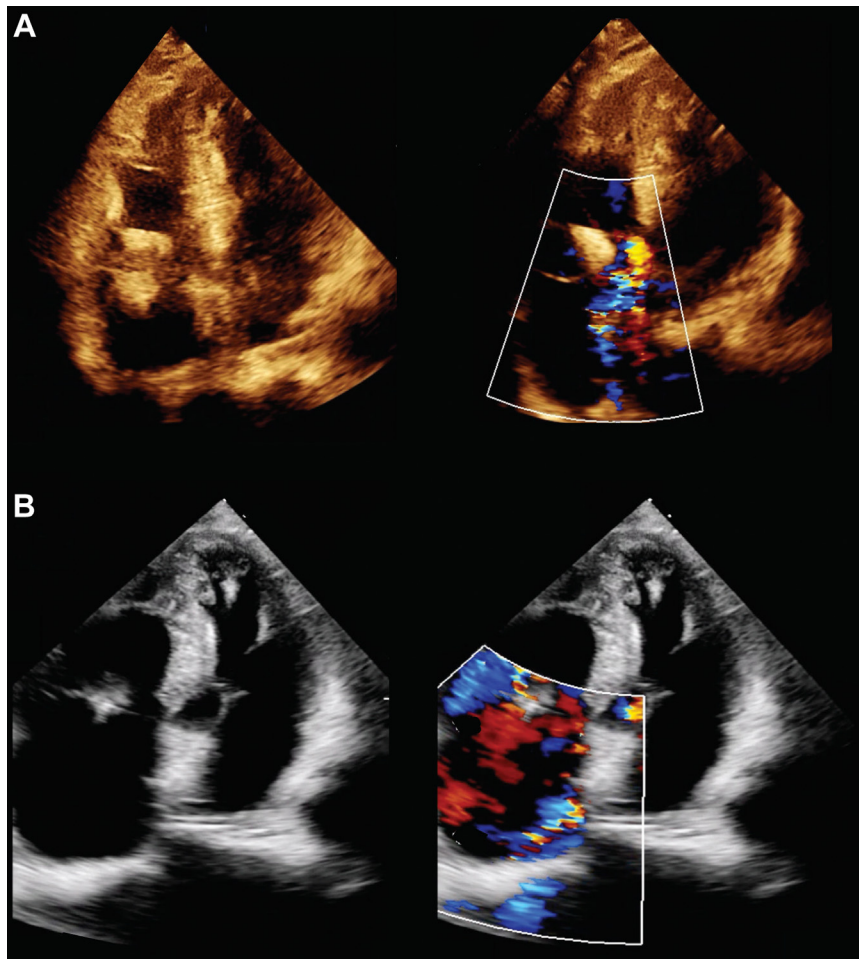
endocarditis and myocardial infarction. Spontaneous chordal rupture causing acute TR, however, is extremely rare.^{3,4} Regardless of the mechanism, POS requires prompt diagnosis to resolve the hemodynamic compromise. Uchihashi et al⁴ reported POS secondary to spontaneous tricuspid valve chord rupture, successfully treated with surgical tricuspid valve repair and PFO closure. Reports exist of POS cases successfully treated by PFO closure alone.^{5,6} Although PFO closure resolves POS symptoms, it does not address TR, right ventricular volume overload, and the risk of RV failure. Theoretically, POS symptoms could also be ameliorated by

tricuspid valve repair alone by reducing and/or redirecting the regurgitant jet, but this approach is less favored due to higher risks of recurrent shunting and ongoing POS symptoms compared with PFO-closure-based approaches.

FOLLOW-UP

Three months postprocedure, the patient was stable, with NYHA functional class II symptoms. Repeat TTE ([Figure 5B](#), [Video 8](#)) confirmed stable moderate-severe TR with well-seated transcatheter edge-to-edge repair devices and no obvious flail segment.

FIGURE 5 TR After Tricuspid TEER



(A) Moderate TR at day 1 after tricuspid TEER (transthoracic echocardiogram). (B) Stable moderate TR at 3 months after tricuspid TEER (transthoracic echocardiogram). Abbreviations as in [Figures 1 and 4](#).

The PFO occlusion device was stable, with no right-to-left shunt across the interatrial septum.

CONCLUSIONS

POS is a rare and debilitating condition that can result from severe TR and right-to-left shunting through a PFO. Contemporary advances in transcatheter therapy can be utilized to effectively manage POS in patients with prohibitive surgical risk.

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KEY WORDS patent foramen ovale, platypnea-orthodeoxia syndrome, transcatheter edge-to-edge repair, tricuspid regurgitation

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