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STRUCTURAL INTERVENTIONS

ADVANCED

CASE REPORT: CLINICAL CASE

Aortic Valve Leaflet Rupture Causing Delayed Left Main Coronary Ostial Obstruction During Valvuloplasty Preceding TAVR

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ABSTRACT

A 69-year-old man with mediastinal radiation history underwent balloon valvuloplasty before transcatheter aortic valve replacement, which caused aortic leaflet rupture leading to unstable severe aortic regurgitation and subsequent left main ostial obstruction. A balloon-expanding valve was implanted to capture the ruptured leaflet and a left main stent was placed. (**Level of Difficulty: Advanced.**) (J Am Coll Cardiol Case Rep 2021;3:1822–1827) © 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 69-year-old man presented to the clinic for persistent dyspnea on exertion. He would get dyspneic if he walked more than 25 feet. On physical examination the patient's vital signs were within normal limits and a grade III/VI systolic ejection murmur was auscultated at the right sternal border.

LEARNING OBJECTIVES

- To understand that aortic valve leaflet rupture can occur from BAV, before TAVR.
- To consider coronary ostial obstruction, from native or prosthetic valve, as a differential diagnosis in patients who presents with anginal chest pain after TAVR.

MEDICAL HISTORY

The patient had a past medical history of atherosclerotic coronary artery disease, atrial fibrillation, Hodgkin lymphoma treated with mediastinal radiation therapy about 20 years ago, hypertension, and diabetes mellitus type 2.

DIFFERENTIAL DIAGNOSIS

Differential diagnoses included congestive heart failure, coronary artery disease, valvular heart disease, or pulmonary hypertension.

INVESTIGATIONS

The patient's echocardiogram revealed severe aortic stenosis (AS) with an aortic valve (AV) mean gradient

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of 55 mm Hg, peak velocity of 4.68 m/s, and AV area of 0.6 cm^2, with mild aortic regurgitation in the setting of preserved left ventricular function. Right-sided and left-sided heart catheterization showed nonobstructive coronary disease, severe pulmonary hypertension with pulmonary artery pressure of 61/21 mm Hg, and confirmation of severe AS with peak to peak gradient and calculated valve area of 62 mm Hg and 0.71 cm^2, respectively. He subsequently underwent evaluation by a cardiothoracic surgery and structural heart team. However, due to the presence of extensive calcification of the ascending aorta and aortic arch (porcelain aorta), as well as prior history of mediastinal radiation therapy, he was deemed a high surgical risk and was consequently advised transcatheter aortic valve replacement (TAVR) as a more viable option (**Figure 1**). His sinus of Valsalva diameter was measured at 32.6 mm, 31.1 mm, and 34.3 mm with left and right coronary ostial height measured at 21.8 mm and 18.5 mm, respectively.

MANAGEMENT

The patient was brought in for a scheduled TAVR procedure with general anesthesia. An Amplatz Left-1 catheter was used over a 0.035-inch straight wire to cross the AV and then was exchanged for a pigtail catheter. A #23 × 4 cm Edwards Balloon was prepped and advanced over the safari wire and positioned across the native valve. The balloon was then inflated, deflated, and then withdrawn into the ascending aorta (**Figure 2**). The patient developed severe hypotension and a transesophageal echocardiogram and aortogram revealed a torn AV left coronary leaflet with prolapse in and out of the left ventricular outflow tract and associated severe aortic regurgitation (**Figures 3 and 4,** Videos 1 and 2). There was no evidence of annular rupture, left ventricle perforation, or pericardial effusion. The patient required intermittent doses of epinephrine for hypotension. The decision was made to proceed and

ABBREVIATIONS AND ACRONYMS

AS = aortic stenosis

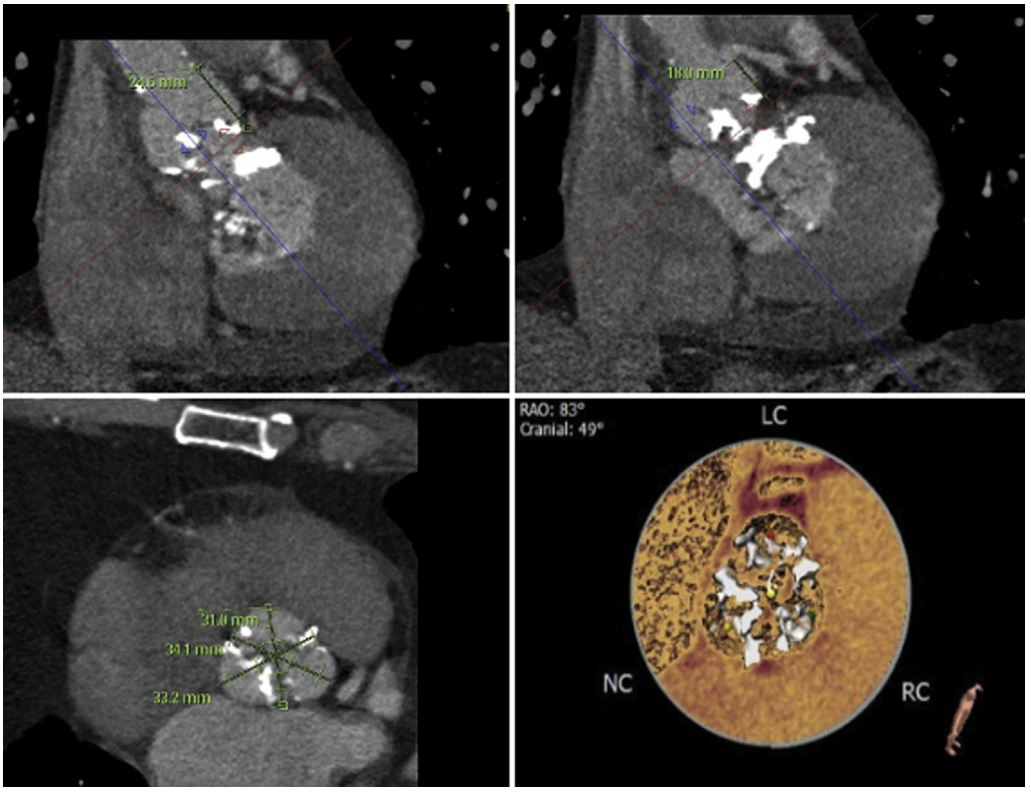
AV = aortic valve

BAV = balloon aortic valvuloplasty

LMCA = left main coronary artery

TAVR = transcatheter aortic valve replacement

FIGURE 1 Computed Tomography Scan



Computed tomography scan images showing extensive calcification of aortic valve and ascending aorta. **(Bottom right)** Calcification using electrocardiogram gated computed tomography scan.

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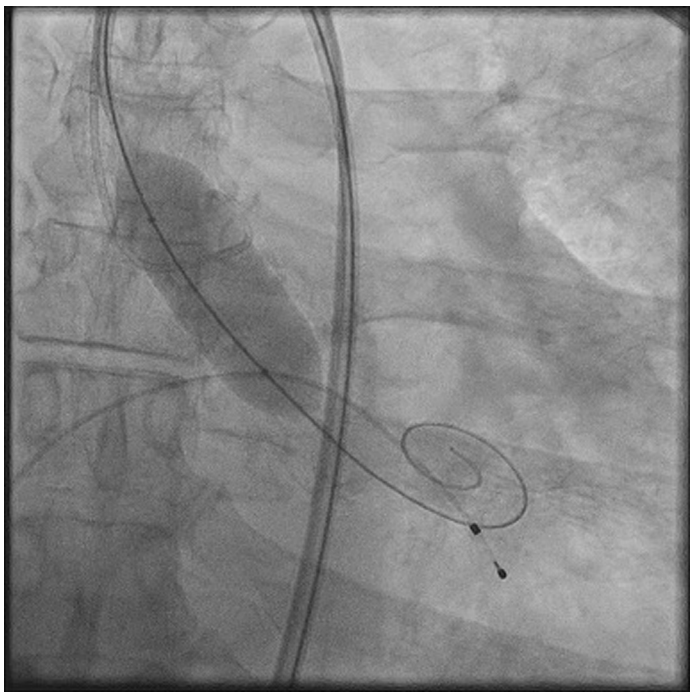
FIGURE 2 Balloon Aortic Valvuloplasty

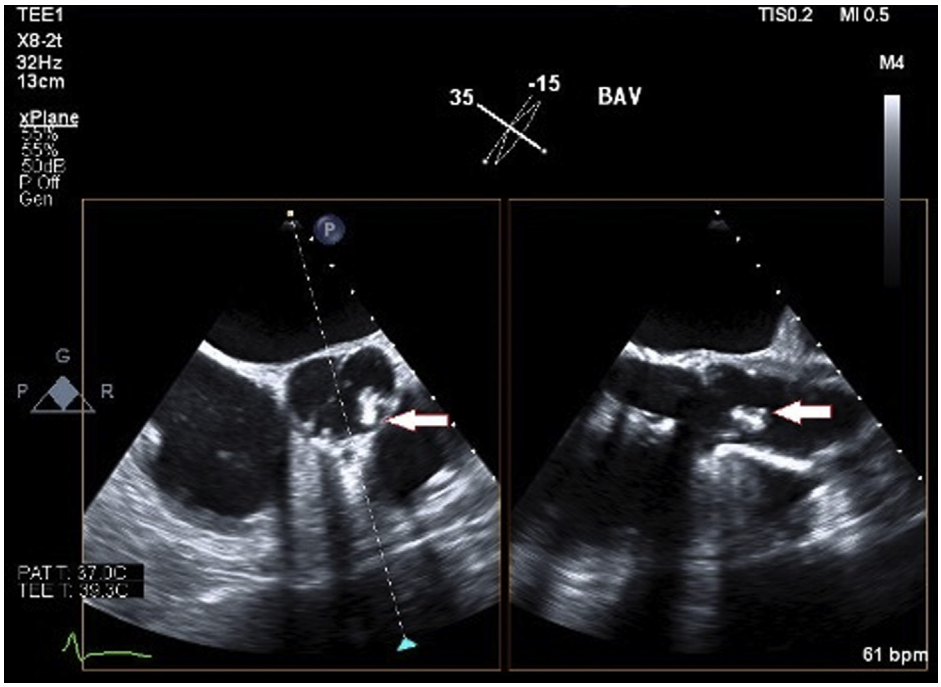


Balloon aortic valvuloplasty being performed before aortic valve placement.

deploy the #26 S3 Edwards Sapien valve with the hope of capturing the ruptured leaflet along the aortic root. Using transesophageal echocardiogram and fluoroscopy, the valve positioning was confirmed and trace perivalvular prosthetic aortic insufficiency was noted (**Figure 5,** Video 3). The patient did well after the procedure and was subsequently discharged home after 2 days.

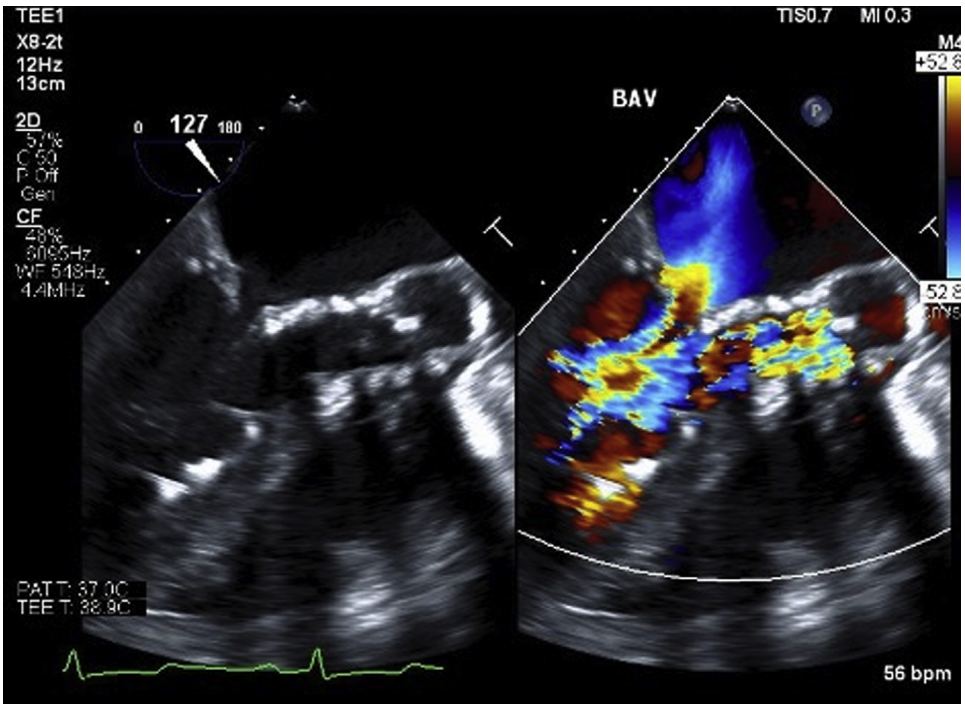
The patient presented to the clinic 3 weeks later with typical symptoms of exertional angina. Selective coronary angiography of left main coronary artery (LMCA) was performed along with intravascular ultrasound. This demonstrated evidence of partial obstruction of the ostial LMCA from the protruding ruptured AV leaflet (**Figure 6,** Video 4). A 60%-70% LMCA ostial obstruction with a minimal luminal diameter of 4.3 mm^2 using intravascular ultrasound was noted (**Figure 7,** Video 4). After discussion with the cardiothoracic surgeons, the decision was made to perform mechanical supported percutaneous coronary intervention. A 4.0 × 15 mm drug-eluting stent was implanted into the LMCA (**Figures 7 and 8**) and postdilated, followed by removal of mechanical support device. The patient tolerated the procedure well and his symptoms resolved.

FIGURE 3 Torn Leaflet on Echocardiography: Transesophageal Echocardiogram



Transesophageal echocardiogram showing torn aortic valve leaflet **(arrows)**.

FIGURE 4 **Flail Leaflet: Transesophageal Echocardiogram**



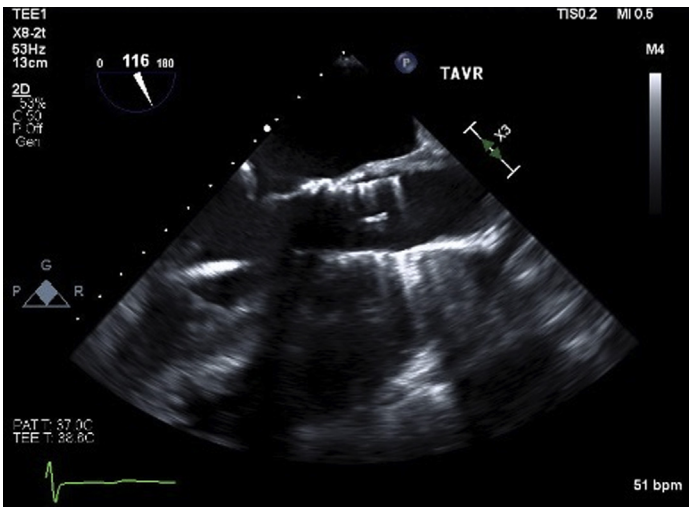
Transesophageal echocardiogram showing severe aortic regurgitation.

DISCUSSION

In the past decade, TAVR has emerged as a minimally invasive alternative treatment method for addressing AS in patients who are deemed high risk for surgery or are not a candidate for surgical aortic valve replacement (1,2). The PARTNER (Placement of Aortic Valves)-1 and 2 trials successfully demonstrated symptomatic improvement and reduction in mortality with TAVR compared with standard conservative therapy, and with surgical aortic valve replacement at 2 years of follow-up (1,3). The major mechanisms by which balloon aortic valvuloplasty (BAV) improves stenosed AV are by fracturing the calcium deposits and separating the fused commissures (4). The force of the inflated BAV breaks these deposits into separate fragments and makes the leaflets flexible and supple and separates the fused commissures (4).

Mediastinal radiation therapy has been the standard of care in treating multiple cancers (5). One of the common late complications of radiation therapy is

FIGURE 5 **Post-Transcatheter Aortic Valve Replacement Echocardiography: Transesophageal Echocardiogram**



Transesophageal echocardiogram image of post-transcatheter aortic valve replacement.

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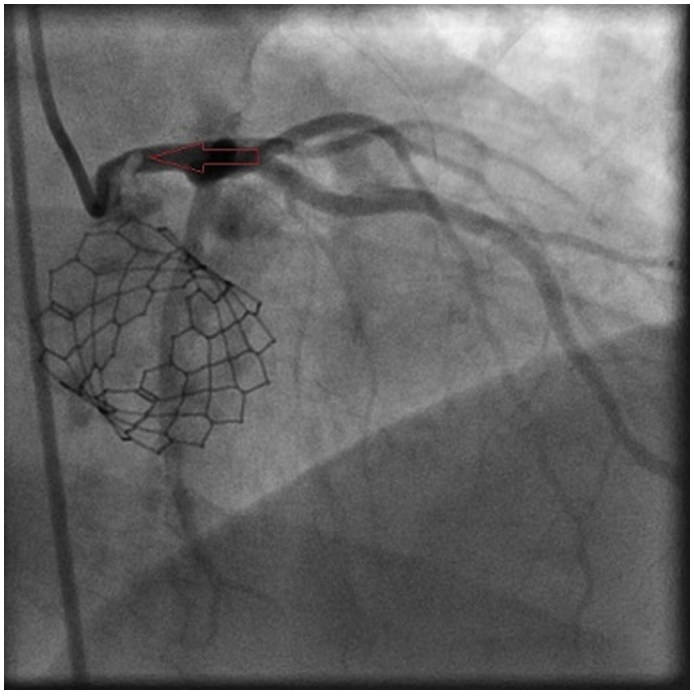
FIGURE 6 Ruptured Left Coronary Aortic Valve Leaflet



Ruptured left coronary aortic valve leaflet partially obstructing the left main coronary artery ostium **(arrow)**.

radiation-induced valvular heart disease, which occurs in about 10%-17% of patients, about 15-20 years after their initial radiation exposure (5,6). AV exposed to mediastinal radiation therapy encompasses more collagen and less calcified tissue than AV not exposed to radiation therapy (6).

Coronary ostial obstruction status post-TAVR implantation is a rare (incidence: 0.4%-2.1%) and devastating complication with 30-day mortality rate of 41% (7-9). Coronary ostial obstruction is primarily due to physical obstruction of the ostium of the coronary artery by the newly implanted prosthetic valve. Persistent hypotension is a common presentation of coronary ostial obstruction, however, typical ST-segment elevation can be present in 25% of the cases (9). Treatment options consist of emergent coronary stenting, coronary artery bypass, or TAVR explant (9). A few studies have concluded that coronary ostial occlusion, although rare, can occur in patients who undergo a balloon expandable Edward Sapien valve implantation compared with other valve implantations (8).

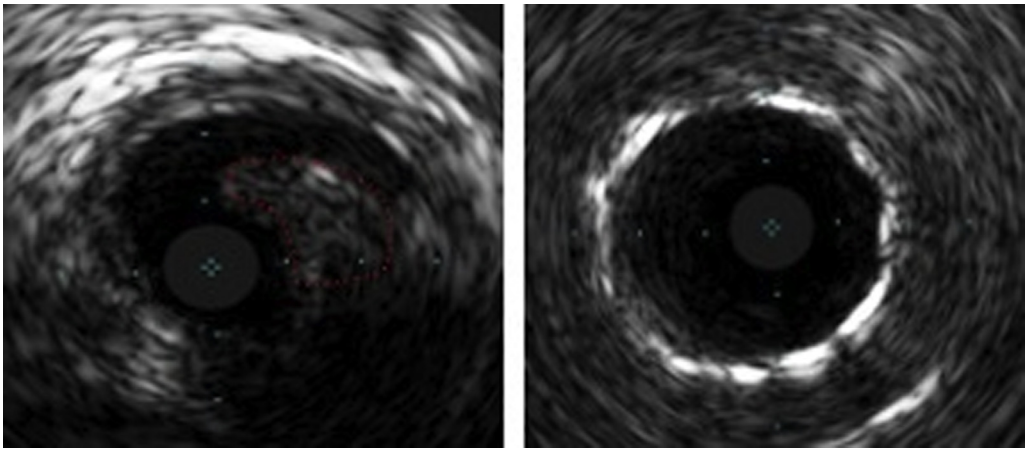
FOLLOW-UP

The patient's dyspnea and anginal symptoms had resolved and was asymptomatic at follow-up.

CONCLUSIONS

The risk of focal leaflet rupture is elevated in patients with radiation-induced valvular heart disease

FIGURE 7 Intravascular Ultrasound Imaging



Intravascular ultrasound imaging demonstrating left main coronary ostial obstruction by ruptured leaflet **(dotted line in left image)** and widely patent stent after stent implantation **(right)**.

because the fibrotic thickening, scarring, retraction, and focal calcifications involve the medial and basal sections of the valve, rather than the valvular tips (5,6). Here, we presented a rare case of AV leaflet rupture after BAV, before TAVR, in a patient with mediastinal radiation exposure leading to radiation-induced valvular heart disease. Moreover, our patient had a delayed presentation of coronary ostial obstruction from ruptured leaflet that was successfully percutaneously managed. Coronary angiography could be considered to be performed after valve implantation to allow early diagnosis and subsequent management of this potentially fatal complication, especially in patients with existing coronary ostial disease or with low aortic annular to coronary ostial height.

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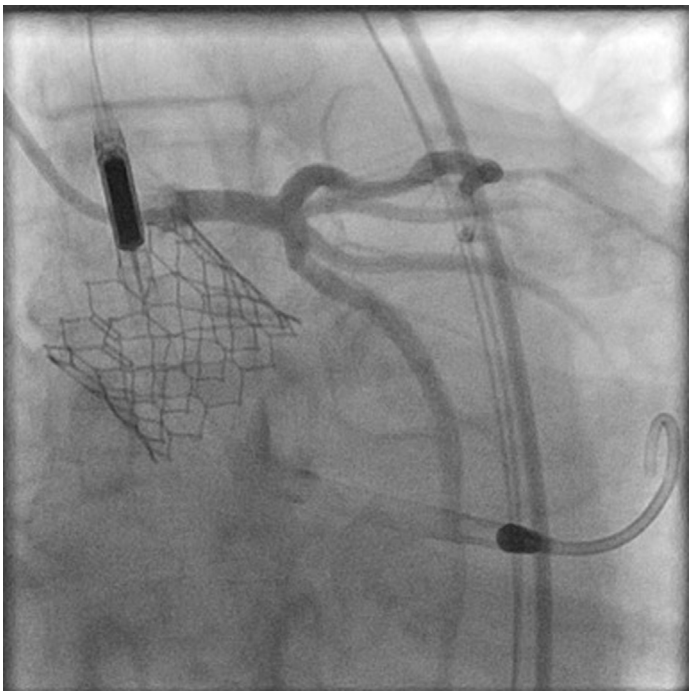
FIGURE 8 Postpercutaneous Coronary Intervention Stenting



Postpercutaneous coronary intervention stenting of the left main coronary artery.

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KEY WORDS aortic valve cusp rupture, balloon aortic valvuloplasty, coronary occlusion, leaflet rupture, radiation-induced valvular heart disease, transcatheter aortic valve replacement

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