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Fulminant Presentation of a Failed TAVR Valve: Successful Revision with a Transcatheter Approach – Case Report and Review of the Literature☆

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ABSTRACT

Transcatheter Aortic Valve Replacement (TAVR) has evolved as a strategy for managing aortic stenosis in a growing proportion of patients considered at high or intermediate surgical risk. Though early data has demonstrated excellent durability and life span of transcatheter valves up to five years, there is an absence of case based studies in the literature regarding transcatheter valve failure after TAVR, and outcomes of subsequent redo TAVR Valve-in-Valve (VIV) procedures. We report here a successful case of emergent, catheter-based treatment for severe, highly symptomatic valve in valve restenosis of a 5 year old Sapien valve.

Contents

1. Introduction

Transcatheter aortic valve in valve implantation (ViV) has become an established alternative for the management of hemodynamically significant aortic stenosis in bioprosthetic valve failure, particularly in patients at increased surgical risk [1,2]. Early studies have demonstrated excellent function of TAVR devices up to five years post implantation [3] with preliminary studies reporting evidence of early trancatheter valve degeneration approximately eight years after implantation [4]. While follow-up studies have assessed the outcomes of a surgical approach to redo of surgical aortic valve replacement (i.e., SAVR), there are very few case studies in the literature regarding redo TAVRs necessitated by trancatheter valve failure. Given the rarity of VIV restenosis in the TAVR population, delay in recognition and diagnosis may lead to worsening prognosis. We describe here a case report of a successful redo of a TAVR VIV done five years after index procedure and performed emergently in a critically ill, high risk patient.

1.1. Case report

A 66 year old female was directly admitted to the intensive care unit for acute hypoxic respiratory failure and hypotension; her past medical history was notable for previous diagnosis of bicuspid aortic valve, severe symptomatic aortic stenosis with TAVR performed five years prior to this admission. She had history of heart failure with preserved ejection fraction (HFpEF), rheumatoid arthritis with intermittent use of steroids, type 2 diabetes, and a 15 pack year tobacco history with COPD; at the time of her TAVR in 2013, she had been considered a high risk for surgical intervention given short stature with kyphosis, chest wall deformity, small valve size with probable need for root enlargement, pulmonary function tests with low FEV1, and other comorbidities. She had done very well following TAVR with return to work

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and excellent overall functional status. Follow up echocardiography at 30 days and 1 year showed good prosthetic valve function and mean gradients less than 15 mm Hg. Approximately 4.5 years after implant, she developed increasing progressive dyspnea that was attributed to chronic obstructive pulmonary disease. Her functional status declined; she did not respond to inhalers or steroids. During the index admission to the outside hospital, Chest X-ray had shown cardiomegaly and central vascular congestion indicative of pulmonary edema. *Trans*-thoracic echocardiogram (TTE) performed at the outside hospital showed EF 48%, mild left ventricular hypertrophy, mild pulmonary hypertension (PAP 43 mm Hg), a well seated 23 mm Edwards Sapien aortic valve prosthesis with significantly elevated valve gradients (peak: 141 mm Hg, mean: 80 mm Hg, and Vmax 594 cm/s), indicating severe prosthetic valve dysfunction.

The patient was transferred to our tertiary referral center for ongoing management and consideration of redo valve replacement. The patient had initially symptomatically improved with diuresis and use of non-invasive positive pressure ventilation (NIPPV). She was evaluated by the Structural Heart Team, and work-up was initiated for valve replacement (TAVR vs SAVR). Subsequent 2D TEE (Fig. 1) showed the 23 mm Sapien valve in the aortic position with severe stenosis, heavily calcified leaflets, markedly reduced excursion, and an EF of 50%. A CT scan of the chest with dedicated 4D dynamic imaging of the aortic root also demonstrated the Sapien valve with significant calcifications of the aortic cusp (Fig. 2A–D). Thrombus was not clearly identified on the heavily calcified leaflets. Diagnostic cardiac catheterization showed elevated pulmonary capillary wedge pressures, PA pressure of 45/18, and normal coronary arteries. The prosthetic valve was not crossed.

Within 24 hours of transfer, the patient's clinical status rapidly deteriorated, requiring transfer to the ICU. Her respiratory distress worsened despite adequate diuresis, and a repeat of her chest x-ray showed new infiltrates. On re-evaluation in the intensive care unit, it was felt her worsening clinical status made her high risk for surgical intervention, and the decision was made to proceed with an emergent TAVR VIV procedure without delay.

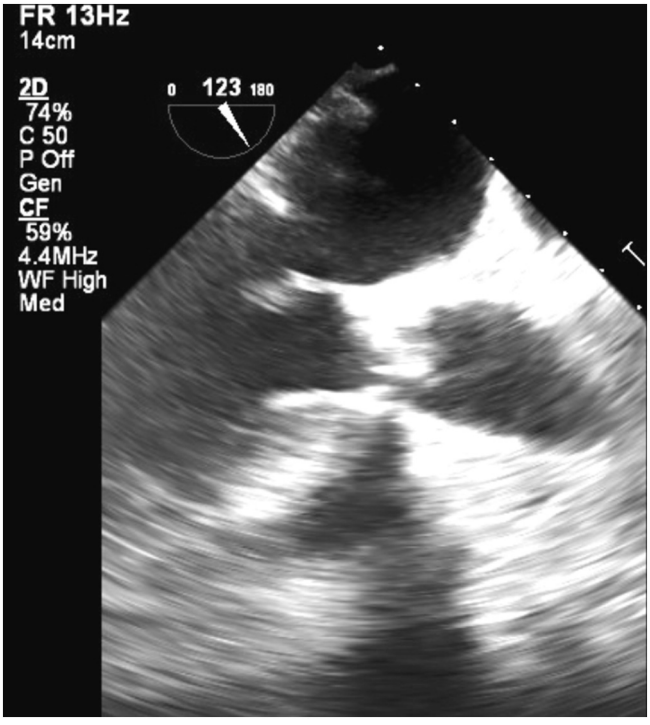

Fig. 1. Transesophageal long axis view of heavily calcified and stenotic Sapien valve prior to re-intervention.

1.2. Procedural details

Access was obtained in the left femoral artery (LFA) and vein (LFV) without complication. A temporary pacing wire was placed at the LFV, and good thresholds were found. For the right femoral artery (RFA), percutaneous access was obtained and two 6 Fr pro-glides were advanced over a J wire and a placeholder 8 Fr sheath was placed in the RFA. The 8 Fr RFA sheath was then exchanged over the wire for a 14 Fr sheath which was placed without complication. The RCA ostium was measured at 7 mm and had an anomalous anterior take-off; to avoid risk of coronary occlusion, it was engaged and wired with an undeployed stent placed in mid vessel prior to valve implantation. The aortic valve was then carefully crossed in a retrograde fashion using a straight wire and AL1 catheter, with simultaneous LV (180/18) and Aortic (115/62 mm Hg) pressures recorded (Fig. 3). Pre-dilatation was not performed in the prosthetic valve prior to introduction of the S3 valve. Optimal implant angle was based on angiographic views of prior TAVR prosthesis, "squaring up" the valve by removing all parallax.

The Sapien S3 valve was prepped and advanced inside the prosthetic Sapien valve. The valve was carefully positioned inside the original TAVR valve, with the goal to align ventricular edge of S3 valve with ventricular edge of original Sapien valve. Once positioned, the valve was deployed with rapid ventricular pacing. After deployment, the valve was post dilated with 2 additional CCs in the inflation system. A post-operative TTE was immediately performed before leaving the OR; there was no aortic insufficiency or paravalvular leak observed, and mean valvular gradient was less than 10 mm Hg post procedure. Given this result, the procedure was considered successful. The stent valve delivery system was removed over the wire, and the undeployed stent in the RCA was removed. A final angiography was performed (Fig. 4).The patient was returned to the ICU for overnight monitoring. She was extubated successfully on post-operative day 3 after vigorous diuresis and pulmonary toilet, and the remainder of her post-operative course was uncomplicated. She was started on a regimen of aspirin and Plavix, and discharged the following week to a rehabilitation facility. Oral anticoagulants were considered, but given the absence of finding of thrombus on CT, and the calcified appearance of the prosthetic leaflets, dual anti-platelet therapy was felt sufficient (see Discussion).

At 30 days' post-operative follow-up, the patient remained off supplemental oxygen, with complete resolution of her symptoms. She had returned to her activities of daily living, was living independently at her home, and she reported she had returned to walking daily, up to 30 minutes at a time. Her repeat echo showed an EF of 55% with a well seated 23 mm Sapien3 aortic valve in valve prosthesis, no perivalvular leak, and mean gradient of 12 mm Hg.

2. Discussion

Transcatheter aortic valve replacement (TAVR) has become an established alternative to surgical valve replacement in patients with severe aortic stenosis, with excellent late clinical outcomes to five years post-procedure [3]. Early studies have shown mechanisms of TAVR device failure to be similar to that of surgically replaced valves [5–8]. In a small study of 50 patients, the most common mechanism of valve failure was moderate/severe para-prosthetic aortic valve regurgitation, occurring in 50% of patients, with other common causes being moderate/severe central prosthetic aortic valve regurgitation and moderate/severe prosthetic aortic valve stenosis [6]. Additionally, it was noted that in the majority of redo TAVR procedures, the identical device type was used, or that of the succeeding generation was employed [5,8].

TAVR failure has been reported due to thrombus formation on the aortic side of the valve with increasing gradients often seen in the early post-implant period [7,9]. This often responds to use of oral anticoagulation [9–11]. It is unknown whether this mechanism is a significant contributor in the later (more than one year) valve failure. In the case discussed here, the patient presented relatively late at

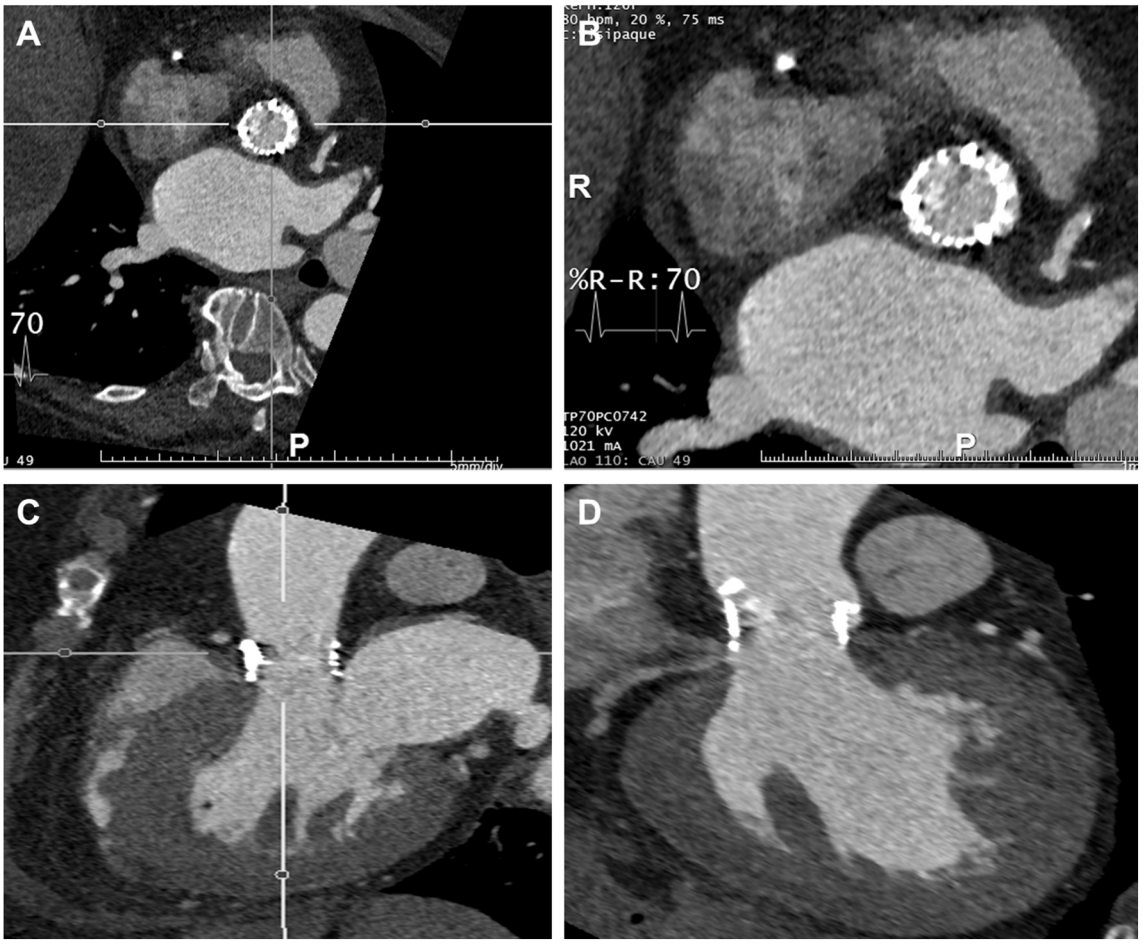

Fig. 2. Use of Pre-operative CTA with tetrospectively gated image acquisition of the heart revealed heavily calcified leaflets of the aortic valve.

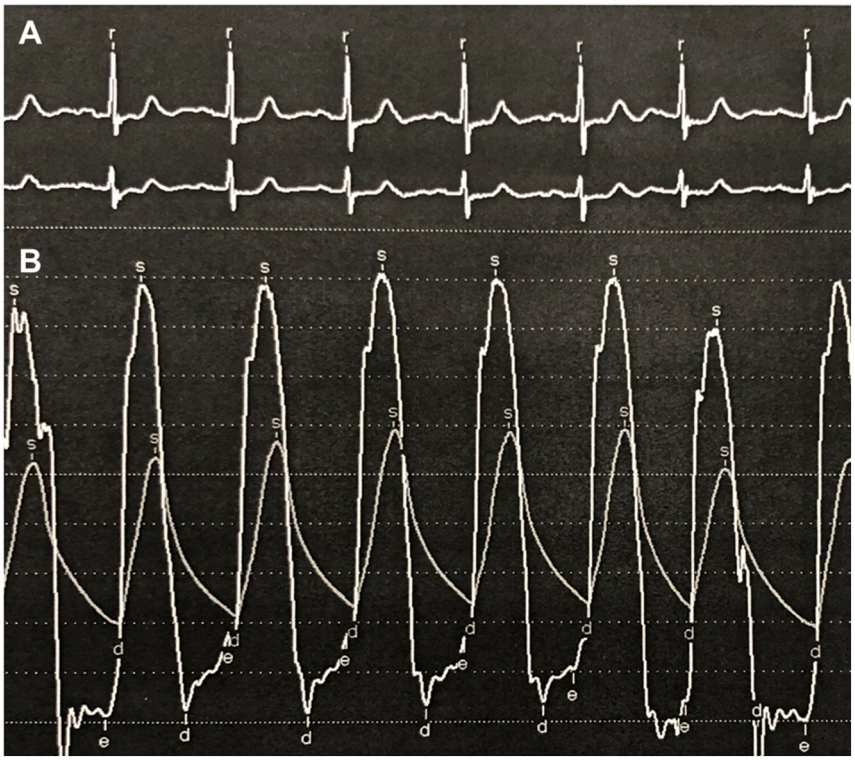

Fig. 3. Simultaneous recordings made of Left Ventricle and Aortic pressures immediately prior to deployment of the Sapien Valve.

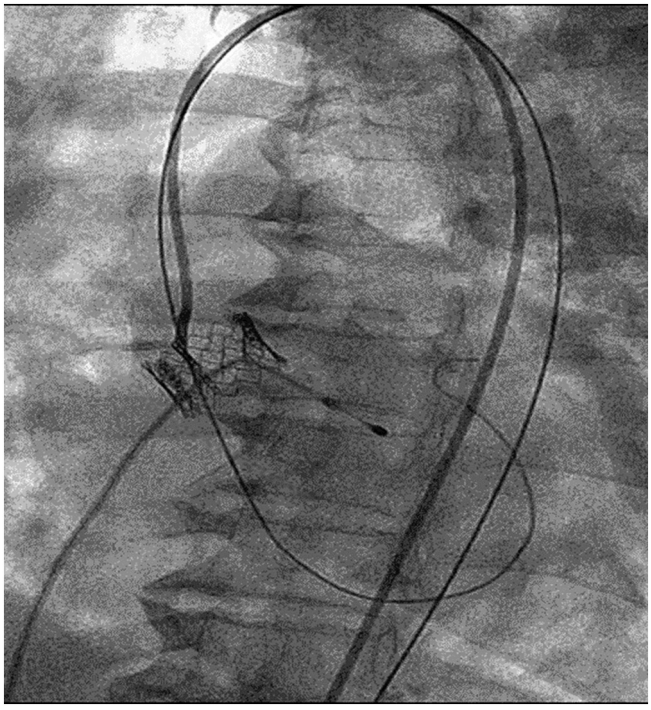

Fig. 4. Final Angiography after deployment of the Sapien Valve.

5 years, and her clinical course was too fulminant to attempt a course of anticoagulation. Following her second TAVR procedure, we chose a DAPT strategy of aspirin 81 mg and clopidogrel 75 mg for 6 months, with lifelong aspirin to follow, consistent with 2014 and 2017 AHA/ACC guidelines [12]. As per our program's clinical guidelines, oral anticoagulation is used only when elevated gradients are detected at 30 day or one year echo surveillance. Given the lack of data on the mechanisms of late transcatheter valve failure and role of oral anticoagulation following redo valve in valve TAVR, further study on optimal strategy (dual antiplatelet therapy vs oral anticoagulation) is warranted.

Given the expanded use of TAVR in patients of both intermediate and high surgical risk [1,2] the number of patients who undergo TAVR procedures are expected to increase, and to potentially include those at low surgical risk and those of younger ages. More studies are needed on long term durability of transcatheter valves, and indications for redo TAVR. Furthermore, recognition of graft failure is clinically important; in the case described in this report, early signs and symptoms were missed clinically for months despite repeated visits to primary care providers and pulmonary specialists, and this allowed progression to a life-threatening condition requiring ICU admission and emergent intervention.

2.1. Summary

We report here a case of redo TAVR in an emergent setting after delayed recognition of progressive prosthetic valve failure five years after index procedure. This case adds to early reports of successes with valve in valve TAVRs, and demonstrates this procedure to be an effective treatment for a critically ill patient with an excellent clinical result.

3. Conclusion

We show here that redo TAVR VIV procedures may be performed safely and feasibly in critically ill patients at high surgical risk. More information is needed on incidence of TAVR VIV stenosis to develop a greater awareness of this diagnosis and for prevention of complications.

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