CASE REPORT

Valve in Valve Trans-Catheter Aortic Valve Replacement Followed by LVAD Deactivation in the Setting of Recovered Systolic Function

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Abstract: Background: Advanced heart failure has extremely high mortality without advanced therapies (left ventricular assist device (LVAD) implantation or cardiac transplant). LVAD patients with bioprosthetic aortic valve are more prone to leaflet fusion resulting in valvular stenosis and regurgitation.

ARTICLE HISTORY

Received: February 13, 2019

Revised: April 22, 2019

Accepted: April 24, 2019

DOI:

10.2174/1573403X15666190509082833

Case Presentation: We present a 46-year-old patient who had LV systolic function recovery while on LVAD. However, he had a severely stenotic aortic valve bioprosthesis with leaflet fusion that had to be replaced before deactivating his LVAD. Due to high surgical risk, we performed valve-in-valve Trans-Catheter Aortic Valve Replacement (TAVR) with an Evolut self-expanding valve, however, the patient had significant aortic regurgitation secondary to deployment above the bioprosthetic valve ring. We successfully deployed a second Evolut Self-expanding valve inside the ring with excellent results. This was followed by a successful LVAD deactivation next day. His LV systolic function continued to recover and he had no heart failure symptoms at 3 month follow up. In the right settings, TAVR in recovered LVAD patients with aortic stenosis as a bridge to LVAD deactivation is a viable option, especially for patients who fall in the high-risk group.

Conclusion: To the best of our knowledge, this is the first reported case of a valve-in-valve TAVR followed by successful LVAD deactivation in the setting of recovered LV systolic function

Keywords: Left ventricular assist device, trans-catheter aortic valve replacement, valve in valve, heart failure, cardiac transplant, stenosis, non-ischemic cardiomyopathy.

1. INTRODUCTION

Advanced heart failure has an 80% mortality at 5 years unless advanced therapies (left ventricular assist device (LVAD) implantation or cardiac transplant) are done. LVADs are being increasingly used as destination therapy [1] in patients who are not candidates for a heart transplant. However, a minority of patients recover and may benefit from LVAD deactivation. Valvular abnormalities need to be corrected before LVAD deactivation. We present a complex patient with recovered left ventricular systolic function who had a valve-in-valve TAVR followed by successful LVAD deactivation.

2. CASE PRESENTATION

A 46-year-old male patient with end-stage non-ischemic cardiomyopathy (NICM) with multiple heart failure related admission underwent Heart Mate II left ventricular assist device (LVAD) implantation as a destination therapy. The patient was not a transplant candidate secondary

to drug use. He also underwent aortic valve replacement (AVR) with a 23 mm Edwards Magna Ease bioprosthesis at the time of LVAD implantation because of severe aortic insufficiency. His post-implantation course was unremarkable. The patient was followed in our advanced heart failure clinic and his symptoms improved over a few months. One year after LVAD implantation, he had only occasional heart failure symptoms with exertion consistent with New York Heart Association functional class I (NYHA class I) and his left ventricular systolic function recovered with a left ventricular ejection fraction (EF) that improved to 45%. The heart team recommended LVAD decommissioning. However, his bioprosthetic aortic valve leaflets were partially fused (Fig. 1) resulting in severe aortic stenosis with an effective orifice area of 0.6 cm² (Fig. 2-4). The patient's surgical risk was high and he was referred for Trans-catheter Aortic Valve Replacement (TAVR). After discussing his case in the multidisciplinary valve conference, we proceeded with TAVR through a left subclavian approach due to severe ilio-femoral disease bilaterally. After surgical cut-down of the left subclavian artery, a 14-French sheath was introduced and the bioprosthetic aortic valve was crossed. A pigtail catheter was advanced into the left ventricle for initial hemodynamic measurements. For the measurements, LVAD speed was

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Fig. (1). Bioprosthetic aortic valve fused leaflets (arrow). (A higher resolution / colour version of this figure is available in the electronic copy of the article).

Fig. (2). Bioprosthetic aortic valve effective orifice area of 0.6 cm^2 by direct planimetry, consistent with critical aortic stenosis. (A higher resolution / colour version of this figure is available in the electronic copy of the article).

Fig. (3). Superior displacement after deploying the first transcatheter valve above the bioprosthetic valve ring (arrow). (A higher resolution / colour version of this figure is available in the electronic copy of the article).

turned down and the mean gradient was 18 mmHg along with mild aortic insufficiency. The pigtail was exchanged for an extra stiff Amplatz guidewire. Under fluoroscopic

Fig. (4). Placement of a second transcatheter valve within the bioprosthetic ring (arrow). (A higher resolution / colour version of this figure is available in the electronic copy of the article).

and angiographic guidance, a 26 mm Evolut self-expanding valve was advanced to the aortic position and placed within the failing bioprosthetic valve. When the valve was delivered, we noticed that the Evolut valve was above the ring of the bioprosthetic valve in addition to persistent aortic insufficiency. We elected to leave this valve in that position and proceed with deploying a second 26 mm Evolut self-expanding valve within the ring of the bioprosthetic valve in order to seal the aortic insufficiency and correct the aortic stenosis. Before this was done, it was confirmed that the coronary arteries were appropriately perfused. After that using the same subclavian approach, a new 26 mm Evolut self-expanding valve was delivered and successfully released within the bioprosthetic valvular ring. Intraoperative transesophageal echocardiographic assessment revealed that the valve was well placed, not hindered by the previous valve and that there was no stenosis or insufficiency. More importantly, there was good flow to both coronary arteries. Because of incomplete expansion of the valve due to fusion of the bioprosthetic valve leaflets, post-delivery dilatation was performed by using a 22 mm balloon which resulted in full extension of the valve. Then the left subclavian artery was surgically repaired and the repair was confirmed by angiography *via* the right femoral artery. Finally, the right femoral artery sheath was removed. The patient was extubated and monitored in the Intensive Care Unit (ICU). One day later, he underwent LVAD decommissioning and returned to cardiac ICU for recovery. He tolerated the procedure well with no signs of heart failure. He was restarted on anticoagulation and the next day was up ambulating without difficulty. Before discharge, trans-thoracic echocardiogram showed LVEF of 70%, well positioned aortic valve with a mean gradient of 8 mmHg and no aortic regurgitation or perivalvular leak. The patient was discharged home and had no heart failure symptoms at 3 months follow up. However, he had cellulitis that was treated with oral antibiotics.

3. DISCUSSION

Heart failure is the new epidemic with a prevalence of 5.7 million patients in the United States according to the

CDC 2016 data [2]. Advanced heart failure has an 80% mortality at 5 years unless advanced therapies (left ventricular assist device (LVAD) implantation or cardiac transplant) are done. LVADs are being increasingly used as destination therapy [1] in patients who are not candidates for a heart transplant. More than one-third of all listed adult heart transplant candidates have undergone LVAD implantation since 1999 [1]. However, about 1.3% of LVAD patients have left ventricular systolic recovery [3] and the LVAD can be either explanted or deactivated. Predictors of left ventricular systolic function are age <50 years, non-ischemic cardiomyopathy, time from cardiac diagnosis <2 years, absence of ICD, creatinine ≤ 1.2 mg/dl, and LVEDD <6.5 cm [3]. Due to high surgical risk, trans-catheter approaches have been used in this patient population with either Amplatz occluder devices, melody valve and trans-catheter aortic valve replacement (TAVR) [1, 3-5].

In all previously reported cases, TAVR was used for aortic insufficiency to help the failing left ventricle in the setting of volume overload. This is the first reported case where TAVR was used for a bioprosthetic aortic valve stenosis in the preparation to LVAD deactivation. For successful LVAD deactivation, the patient should have at least close to normal ventricular and valvular function. Significant valvular stenosis or regurgitation may be detrimental to the newly recovered left ventricle after deactivating the LVAD. Planning for the procedure is of critical importance and must be done by a multidisciplinary team to make sure the patient is ready for LVAD deactivation. Meticulous evaluation of aortic valve frequently requires a transesophageal echocardiogram (TEE) to measure the effective orifice area. The continuity equation was not validated in the LVAD population and as such, the pressure gradients and peak velocity across the valve may not reflect the severity of the aortic stenosis. In our experience, real-time 3D imaging added a significant value to the 2D TEE in visualizing the bioprosthesis and the surrounding structures. A very detailed LVAD “turn down” study with hemodynamics documented at different levels of mechanical support is essential before LVAD deactivation. Intra-operatively, real-time TEE helps in evaluating the position of TAVR and any associated perivalvular leak or central regurgitation. Coronary obstruction is a well-known complication of valve-in-valve procedures that is reported to happen in 3.5% of cases [6]. Risk factors include anatomic factors (low-lying coronary ostia, narrow sinotubular junction/low sinus height narrow sinuses of Valsalva, prior root repair, coronary reimplantation), bioprosthetic valve factors (supra-annular position, high leaflet profile, internal or no stent frames, bulky leaflets and presence of thrombus) and transcatheter valve factors (extended sealing cuff and high implantation) [6]. In our case, the first valve was displaced superiorly after delivery and we had to place another Evolut self-expanding valve within the ring of the bioprosthetic valve with good results. Device malposition is another known complication of valve-in-valve procedures and a second transcatheter valve is needed in 8.4% of the time [6]. After a successful procedure, we recommend monitoring in the intensive care unit (ICU) for one day with a re-

peat echocardiogram the next day before LVAD deactivation. Close clinical monitoring is needed afterwards with a low threshold for TEE with any signs of clinical deterioration after LVAD deactivation as the newly recovered left ventricle will have a very limited reserve and systolic function may deteriorate rapidly in the setting of transcatheter valve malfunction. In the right settings, TAVR in recovered LVAD patients with aortic stenosis as a bridge to LVAD deactivation is a viable option, especially for patients who fall in the high-risk group.

CONCLUSION

LVAD patients with bioprosthetic aortic valve are more prone to leaflet fusion resulting in valvular stenosis and regurgitation. In the case of LV recovery, significant valvular disease needs to be corrected prior to LVAD deactivation. We presented a complex patient with recovered EF who had a valve-in-valve TAVR followed by successful LVAD deactivation. In the right settings, TAVR in recovered LVAD patients with aortic stenosis as a bridge to LVAD deactivation is a viable option, especially for patients who fall in the high-risk group.

ETHICS APPROVAL AND CONSENT TO PARTICIPATE

Not applicable.

HUMAN AND ANIMAL RIGHTS

Not applicable.

CONSENT FOR PUBLICATION

No consent was obtained as no patient identifying information were presented.

FUNDING

None.

CONFLICT OF INTEREST

The authors declare no conflict of interest, financial or otherwise.

ACKNOWLEDGEMENTS

Declared none.

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