The impact of the pre-procedural hemodynamic assessment in transcatheter aortic valve replacement

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Introduction

Several reports have shown that up to 70% of all transcatheter aortic valve replacement (TAVR) patients suffer from paravalvuler aortic regurgitation (AR). In approximately 15% of the patients AR is graded as moderate or severe (1, 2). Estimation of the degree of AR during the procedure is frequently done by echocardiografic assessment. However, precise grading of severity of paravalvular eccentric jets poses a major challenge. Using of both pre-and post-procedural invasive hemodynamic parameters in complement with echocardiograpy and angiography provide an additional perspective. Though, hemodynamic evaluation has some important pitfalls that should be kept in mind. We, herein, report a case highlighting such a pitfall and how to avoid it.

Case Report

Seventy-eight-year old woman with severe AS, coronary artery disease (CAD), history of mitral and tricuspid valve repair, diabetes mellitus (DM), hypertension (HT), and hyperlipidemia (HL) presented to our hospital with worsening exertional dyspnea. Two cardiac surgeons concluded that the patient is at prohibitive risk for surgical aortic valve replacement (AVR) due to general debility and high STS score. She was deemed to be a candidate for TAVR.

Procedure was performed under general anesthesia and transesophageal echocardiography (TEE) monitoring. Pre-procedural hemodynamic assessment was done before valvuloplasty (Fig. 1A). Aortic valve gradient was mean 53 mm Hg and peak 110 mm Hg. Then, predilatation was performed with a 20 mm baloon. After valvuloplasty, a 23 mm Edwards-Sapien valve was deployed with rapid ventricular pacing. Immediate outcome of valve deployment was assessed by hemodynamic evaluation which revealed the equalization of the left ventricular (LV) and aorta (Ao) pressure waveforms in late diastole, a phenomenon termed as diastasis and Ao waveform revealed wide pulse pressure (PP). These findings raised concern for moderate or severe AR. However, when pre and post-procedural pressure waveforms were compared it was obvious that similar degree of large PP and the equalization of LV and Ao waves in late diastole were present at pre-procedural tracings which made the utility of post TAVR tracing suspect (Fig. 1). Aortography (Fig. 2) and TEE revealed a well-placed valve, with only trace to mild AR (Fig. 3). Next day, transthorasic echocardiography (TTE) also showed a well-seated valve and mild AR.

Discussion

TAVR is an accepted treatment option for patients with severe AS who are not suitable or at high risk for conventional surgery (3). An important limitation of this technique is paravalvular AR (4). AR, particularly moderate or severe AR is correlated with increased mortality. In some studies, even mild AR is found to be associated with increased

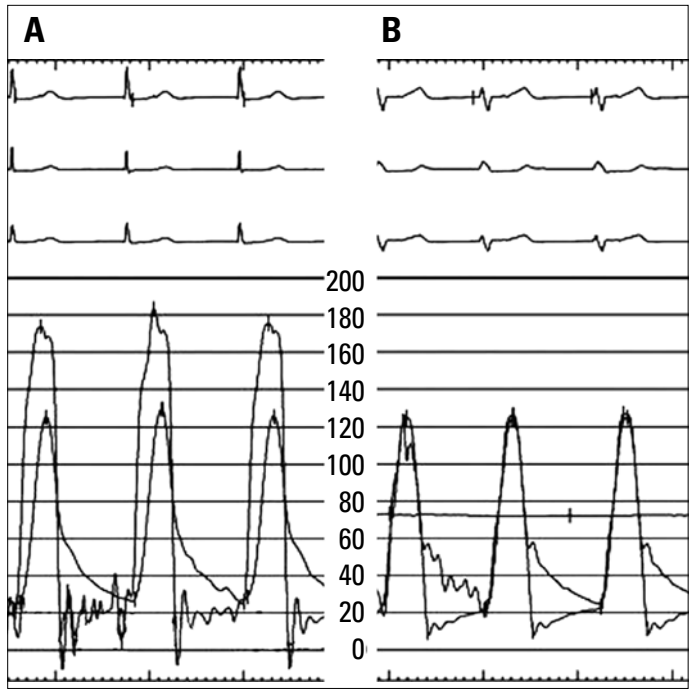

Figure 1. Pressure waveforms before and after TAVR in a 78-year-old patient with severe AS. A. Pre-TAVR: mean gradient=53 mm Hg, LV Peak SBP=176 mm Hg, Ao SBP=126 mm Hg, DBP=26 mm Hg, LVEDP=20 mm Hg. B. Post-TAVR: mean gradient=4 mm Hg, LV Peak SBP=126 mm Hg, Ao SBP=124 mm Hg, DBP=25 mm Hg, LVEDP=22 mm Hg. Comparison of pressure waveforms reveal that the large PP and equalization of LV and Ao waves in late diastole were similar before and after TAVR
Ao - aorta; AR - aortic regurgitation; AS - aortic stenosis; DBP - diastolic blood pressure; LV - left ventricular; LVEDP - left ventricular end-diastolic pressure; PP - pulse pressure; SBP - systolic blood pressure; TAVR - transcatheter aortic valve replacement

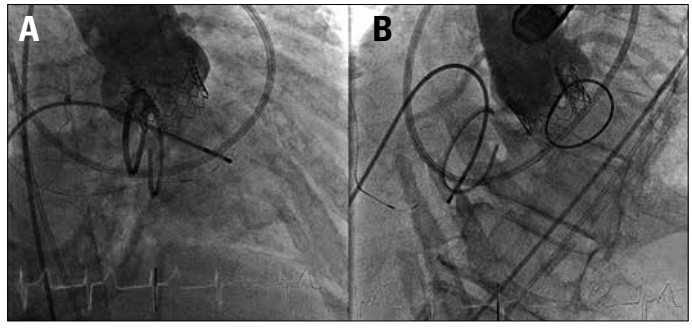

Figure 2. After procedure, RAO (A) and LAO (B) angiographic views show a well-placed valve with faint opacification which cleared each beat
LAO - left anterior oblique; RAO - right anterior oblique

mortality (3). A noncompliant hypertrophied LV with a small cavity does not tolerate acute AR (4).

The severity of AR can be evaluated using TEE, angiography, and invasive hemodynamic parameters during procedure. If moderate or severe AR is confirmed, a baloon inflation and/or valve in valve implantation would be the next step (2).

When evaluating hemodynamic waveforms to predict success of procedure, LV and Ao pressure waveforms should be examined side by side. Both the contour and the peak value of the Ao pressure are altered in patients with AS. The upstroke of the Ao pressure waveform slowly rises at an angle rather than straight up and the diastolic notch is absent or faint on the downslope of the Ao pressure waveform. After valve deployment, no or minimal transvalvular gradient is noted, and

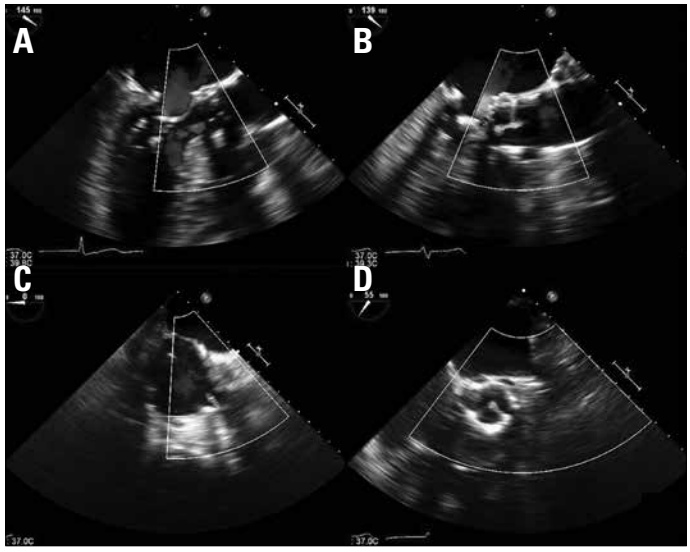

Figure 3. Pre and post-procedural TEE reveal mild degree of AR. (A) Long axis window before procedure shows severely calcifed and narrow aortic valve with mild central AR. (B) Long axis window after procedure shows a well-seated valve and mild AR. (C) Transgastric and (D) short axis windows verify the mild degree of AR
AR - aortic regurgitation; TEE - transesophageal echocardiogram

brisk upstroke of systolic pressure and recovery of a prominent dicrotic notch appear on the Ao pressure waveform. Then, terminal diastolic rise of LV pressure waveform and downslope of Ao pressure waveform should be evaluated. If there is no significant AR, Ao diastolic pressure does not decrease and LV end-diastolic pressure (LVEDP) does not appreciably increase. On the contrary, moderate or severe AR rapidly leads to an increased LVEDP and a decreased Ao diastolic pressure, resulting in large PP. Then, diastasis may also develop (5).

It is important to keep in mind that rising LVEDP, decreased Ao diastolic pressure and large PP can also result from different factors that may influence arterial stiffness, pressure-volume characteristics and compliance of the LV. These factors include heart rate, preload, afterload, pericardial or plevral pressure, diastolic function of LV and LV inotropic state. Both pressure-volume characteristics and compliance of the LV can be altered in several disorders including valvular diseases, pericardial diaseases, cardiomyopathies and coronary artery disease, result in increased LVEDP (6).

On the other hand, stiffness of the vasculature which is frequent in the very elderly and in those with arteriosclerosis frequently causes decreased Ao diastolic pressure and large PP. Aging is the major clinical determinant of arterial stiffness that progressively occurs central arteries more than muscular arteries. Besides aging, HT, diabetes, heart failure, and renal diseases also accelerate arterial stiffness (7). Many patients with multiple co-morbidities such as our 78-year-old patient with CAD, history of mitral and tricuspid valve repair, DM, HT, and HL may have a misleading hemodynamic picture after TAVR unless pre-procedure hemodynamic recordings are available.

Conclusion

Athough increased LVEDP, decreased Ao diastolic pressure and a large PP are usually signs of significant AR, these findings may be present without significant AR as seen in our case. Therefore, the pre-procedural recordings should be examined together with post-procedural pressure waveforms.

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Successful use of a cryoablation sheath for closure of problematic atrial septal defect

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Introduction

Transcatheter closure of atrial septal defects (ASD) of the secundum type with the Amplatzer Septal Occluder (ASO) has become a routine procedure with high procedural success rates. However, certain anatomical aspects, such as defect size and position in the atrial septum that cause some ASDs more difficult to close and requires different techniques. In this case, we describe the successful use of a Cryoablation Sheath for closure of this type of problematic ASD.

Case Report

A 20 years-old woman with ASD was referred to our hospital for percutaneous closure. The transesophageal echocardiography revealed a defect size of 15 mm with sufficient rims (Fig. 1). The procedure was performed under local anesthesia with transthoracic echocardiography (TTE) guidance. The 24 mm sizing balloon was positioned across the