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Case Report

Approach to Transcatheter aortic valve-in-valve implantation with Edwards SAPIEN 3 in elderly with multiple Co-Morbidities: A Case Report

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Abstract

Degenerated bioprosthetic valves are a growing clinical problem with significant morbidity and mortality. The incidence of aortic bioprosthesis structural valve deterioration (SVD) requiring reintervention. Repeat surgery using mechanical or tissue prosthesis was the preferred treatment for the last several decades. However, reoperation has a higher risk of complications due to technical complexity, advancing age and multiple comorbid conditions. Recently, successful implantation of transcatheter Valve-in-valve (ViV) procedures have emerged, especially in high surgical risk patients with excellent results. Though transcatheter ViV procedure is less invasive compared to surgical aortic valve replacement, it is associated with specific complications requiring extensive preoperative work-up and planning by the heart team. We report a 93-year-old male patient with multiple comorbidities, deemed high risk for surgical intervention.

Keywords: degenerated bioprosthetic valve; valve-in-valve (ViV) implantation; edwards sapien-3 valve; multiple co-morbidities; haemodynamics; ViV-TAVI

Short title: Transcatheter aortic valve-in-valve implantation in elderly patient with multiple co-morbidities.

Introduction

The concept of transcatheter insertion of heart valves as a treatment option for valvular heart disease has been around since 1960s [1]. It was not until 2000 that the first implantation of a transcatheter pulmonic valve in a human being was realized [2]. Cribier et al in 2002 [3] described the first percutaneous transcatheter implantation of an aortic valve prosthesis in a 57-year-old patient with calcific aortic stenosis. The concept of transcatheter implantation of a new valve within the failing bioprosthetic valve (ViV) was first described by Walther et al [4]. The first successful transcatheter aortic valve implantation for degenerated surgical aortic bioprosthetic valve was done by Wenaweser et al in 2007 [5]. Since then, several case studies from Europe and Canada have confirmed the successful implantation of off-label transcatheter aortic valve implantation (TAVI) valves within failing bioprosthetic valves (5). With the TAVI procedure expected to progress into younger patient populations, valve-in-transcatheter aortic valve replacement-TAVR (ViV-TAVI) may become a more frequent consideration as increasing number of surgically implanted bioprostheses will require re-intervention for structural valve deterioration in the future (6-8].

However, this procedure is not without its inherent risks. Knowing the internal diameter of bioprosthetic valves is crucial towards planning a successful ViV-TAVI procedure. The type, size, and implant position of the transcatheter valve has to be optimized for individual patients with knowledge of previous surgical bioprosthesis valve implanted,

radiographic and echocardiographic measurements, haemodynamics and structural anatomy for better clinical outcomes. This can prevent malposition, coronary occlusion, device under expansion, and residual aortic stenos is after ViV-TAVI. Here, we describe for the first time a case of aortic ViV-TAVI procedure in an elderly individual (93yrs old) with degenerated bio-prosthetic valve and multiple co-morbidities, in addition to several anatomical constraints.

Case presentation

A 93-year-old male, known case of hypertension, hypothyroidism and ischemic heart disease (IHD) with prior history of dyspnea on exertion and orthopnea. He gave a past history of aortic valve replacement (AVR) surgery with a 23mm SJM St. Jude Medical-bioprosthetic stented porcine valve 15 years back and concomitant coronary artery bypass surgery (CABGS) with two grafts [left internal mammary artery (LIMA)-left anterior descending (LAD) and saphenous vein grafts (SVG)-right coronary artery (RCA)]. There was no history of fever or chest trauma in the recent past.

Hemoglobin content was 8 gm/dL. The levels of liver enzymes such as alanine amino transferase-ALT (250 U/L) and aspartate amino transferase-AST (320U/L) were raised. N-terminal (NT)-proB-type Natriuretic Peptide (NT-proBNP) level was 9200 pg/mL. Serum creatinine level was 3.94 mg/dL. Transthoracic echocardiography (TTE) showed dilated left atrium (LA) and left ventricle (LV). There was thickening and calcification of the tissue aortic valve leaflets, causing moderate to severe aortic regurgitation (AR). AR pressure half time (PHT) was 195 ms with regurgitant fraction (RF) of 48 mL. LV ejection fraction was 45% with hypokinesia of inferior myocardial wall with mild mitral and tricuspid regurgitation. Pulmonary hypertension was also mild (38 mm Hg).

Computed Tomography (CT) based aortogram showed calcification in annulus, ascending arch and descending aorta with tortuosity. The following diameters were measured on CT scan (**Fig.1**).

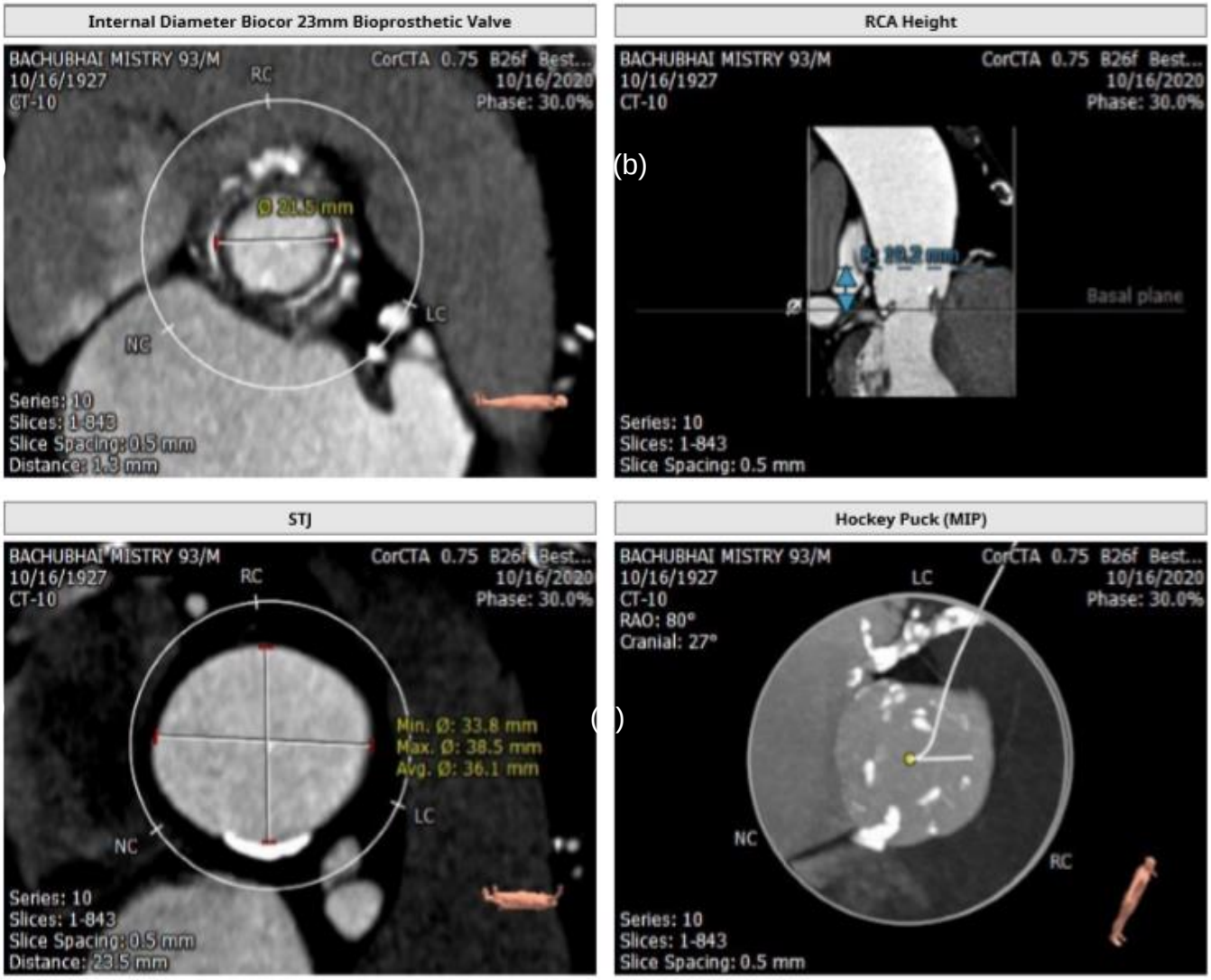

Figure 1. *Computed Tomography (CT) based aortogram showing various dimensions of the bioprosthetic aortic valve and root. Aortogram showed calcification in annulus, ascending arch and descending aorta with tortuosity (a-d).*

Annulus (internal diameter) min/max; 19/22 mm, effective 20/20 mm (area/ circumference), mid-sinus 26 mm, sino-tubular junction 23 mm, distance to the left coronary ostium 9 mm and to the right coronary ostium 13 mm. Both common iliac (9 mm) and femoral artery (8 mm) diameters were adequate (**Fig. 2**).

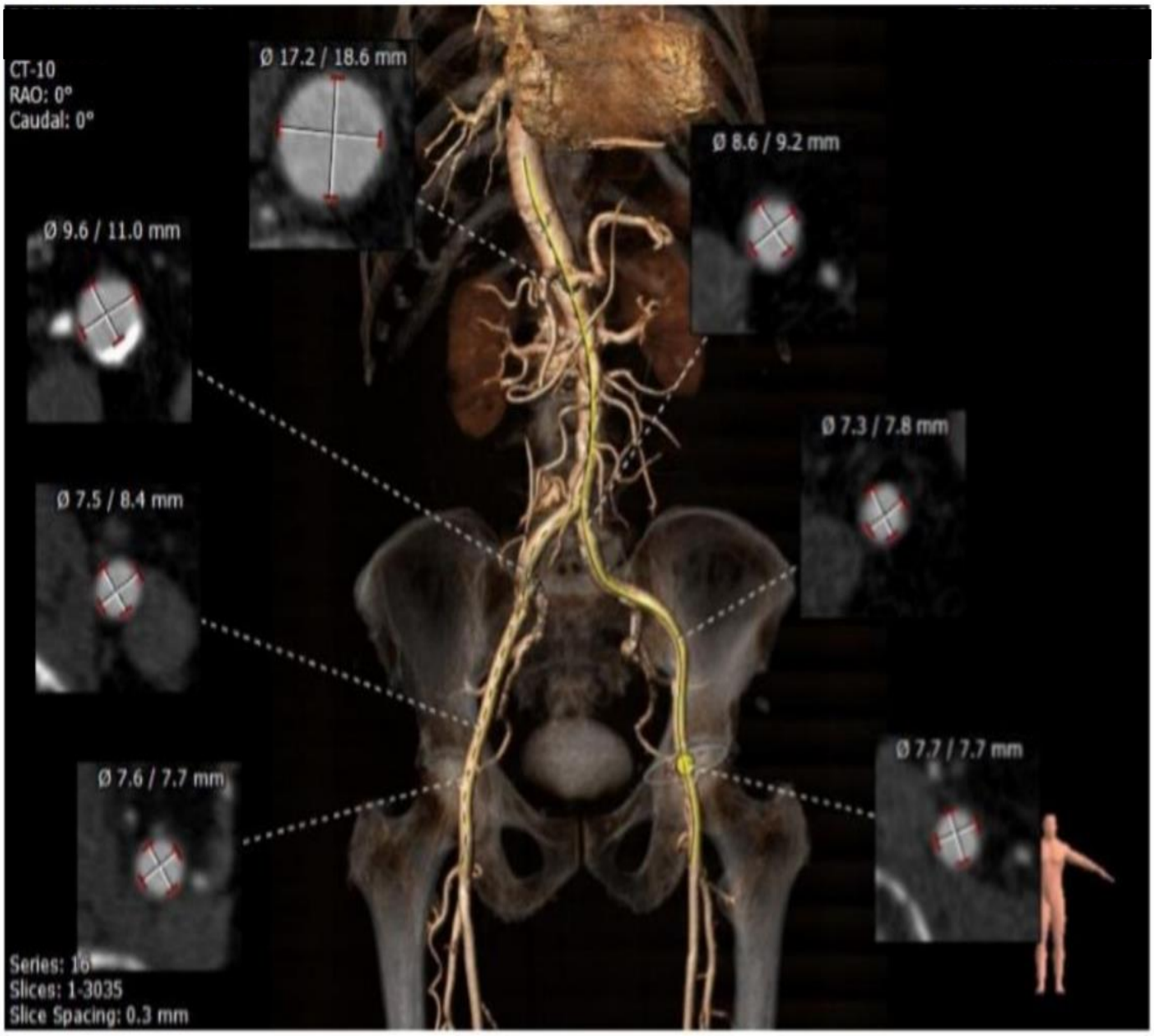

Figure 2. *Computed Tomography (CT) image showing various dimensions of the peripheral arteries.*

CT-coronary angiography showed a patent LIMA-LAD graft. SVG-PDA graft was occluded with good retrograde collateral circulation to distal RCA via epicardial vessels from left circulation. In view of high surgical risk (STS score of 15%) and multiple comorbidities, a transcatheter aortic ViV implantation with ES3V was planned on compassionate grounds.

Procedure

During TAVI procedure, a 14 French sheath was inserted and sutured into place. The Sapien 3 commander delivery system was inserted and the valve was aligned in the descending aorta. The 23 mm ES3V was deployed with slow continuous inflation during rapid right ventricular pacing (200 bpm). The cranial edge of the ES3V was aligned with the cranial radiopaque markers of bioprosthesis to minimize paravalvular leak. Post-deployment angiography, transesophageal echocardiography and aortogram confirmed good valve placement with only a mild aortic paravalvar leak and reduction in trans-aortic gradient when compared to a naïve 23 mm Biocor stented bioprosthetic valve (**Fig.3a-d**).

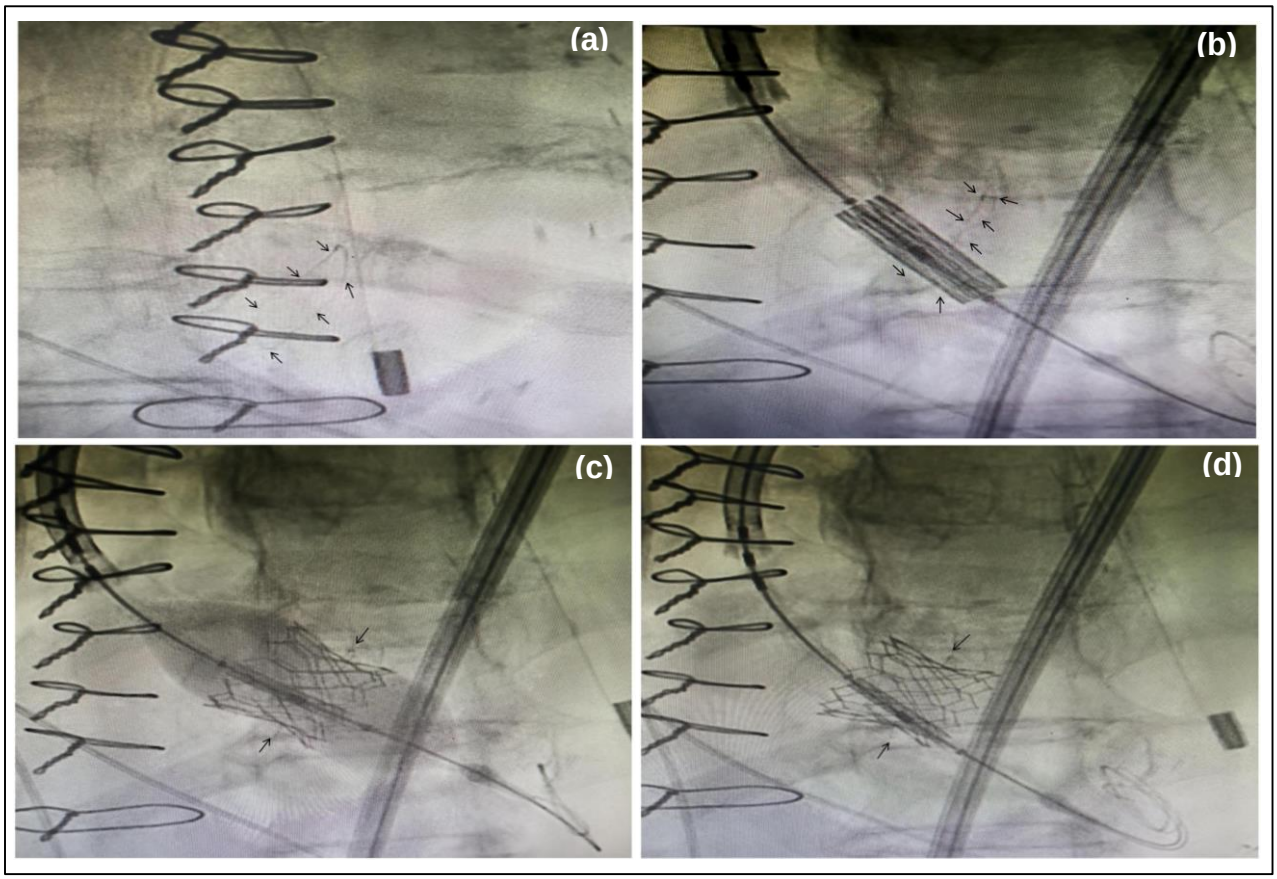

Figure 3(a). *Angiographic film showing the sewing ring of a 23 mm Biocor (Bioprosthetic) valve (Arrows), (b). Angiographic film showing the positioning of the 23 mm ES3V within the degenerated aortic tissue valve ring (Arrows), (c). Angiographic film showing inflation of the balloon-expandable ES3V within the older degenerated aortic valve (Arrows) and (d). Angiographic film showing Valve-in-Valve deployment of ES3V (Arrows).*

To the best of our knowledge, no report is available on transcatheter aortic valve-in-valve implantation with Edwards SAPIEN-3 in a 93 Years old male patient having multiple co-morbidities.

Discussion

Aortic bioprosthetic valves usually deteriorate in 10 to 20 years after surgery. The operative mortality for elective redo aortic valve surgery has been reported to range from 2-7%. However, this percentage can increase to over 30% in high-risk patients [9]. Transcatheter valve-in-valve implantation (ViV-TAVI) has now evolved as an alternative to redo surgical valve replacement for high-risk patients with aortic bioprosthetic valve dysfunction. Advanced age, female sex, high preoperative New York Heart Association functional class, left ventricular dysfunction, renal failure, pulmonary disease, cognitive impairment, urgency of operation and technical difficulties caused by chest wall adhesions have been identified as predictors of higher reoperative risk [10-12].

In a meta-analysis on 489 patients, 227 underwent ViV-TAVI and 262 underwent redo-SAVR, showed that the 30 day mortality was similar in 2 groups (5% vs 4%; odds ratio [OR] = 1.08, 95% confidence interval [CI] = 0.44 to 2.62). There were similar rates of stroke (2% vs 2%; OR = 1.00, 95% CI = 0.28 to 3.59), myocardial infarction (2% vs 1%; OR = 1.08, 95% CI = 0.27 to 4.33), and acute kidney injury requiring dialysis (7% vs 10%; OR = 0.80, 95% CI = 0.36 to 0.1.77) between 2 groups but a lower rate of permanent pacemaker implantation in the ViV-TAVI group (9% vs 15%; OR = 0.44, 95% CI = 0.24 to 0.81) [13].

Type of surgically implanted valves also guide the choice of TAVR valve, since in valve-in-valve (ViV) procedure with a stented bioprosthesis, the sewing ring and frame provide an anchor for the THV; hence, the procedure can be performed with relative ease. In stentless valves, due to the lack of a stent frame and sewing ring results in the absence of radiopaque markers to allow proper VIV positioning, makes the procedure more challenging. Moreover, different sewing techniques and the proximity to the coronary ostia can make the ViV procedure technically more difficult **[**8, 14].

Choosing the correct type and size of the transcatheter heart valves (THVs) device is also important. THVs are available either as balloon expandable or self-expandable valves. There is currently a stronger inclination to use the self-expandable THV with a nitinol frame when performing ViV in a stentless bioprosthesis and balloon expandable valves for stented bioprosthesis. Coronary obstruction following VIV implantation is a rare but life-threatening complication that requires immediate cardiopulmonary resuscitation and reinstitution of coronary blood flow. It is rarely seen with degenerated Mitroflow (Sorin) and Medtronic Hancock bioprosthesis [14, 15].

The third generation Edwards SAPIEN-3 transcatheter heart valve (ES3THV) is associated with improved outcomes and lower rates of major vascular complications and Paravalvar leak, but has higher rates of new PPM implantation, compared to other valves [16,17]. As per the STS/ACC transcatheter valve-in-valve therapy registry (TVTR), a database extract performed on August 4, 2016, yielding 314 patients that had been treated with an ES3THV, placed in a failed surgical aortic

bioprosthesis, showed all-cause mortality of 2.5% at discharge and 4.5% at 30 days (18). The incidence of ischemic stroke was 1.0% and minor vascular complications was 3.8% at discharge [18]. In a study by Kim et al [19], showed that ES3THV with higher radial force may have more advantages as compared to other devices with lower radial force, in heavily calcified aortic anatomies.

Conclusion

With an improvement in life expectancy and lower age at which patients opt for a bioprosthetic valve, it is inevitable that an increasing number of patients will present with bioprosthetic valve dysfunction. Transcatheter valve-in-valve is an accepted treatment in high surgical risk patient. Therefore, we recommend that understanding the complexities of the ViV procedure can lead surgeons to make choices during the original surgical valve implantation that can make a future ViV operation more technically feasible, years before it is required.

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