Masters of Cardiothoracic Surgery

Fracture of a 21 mm failed bioprosthetic aortic valve

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Clinical vignette

A 71-year-old female with prior single vessel coronary artery bypass (left internal mammary artery to left anterior descending artery) and aortic valve (AV) replacement (21 mm Magna Model 3000, Edwards Lifesciences, Irvine, CA), presented with dyspnea. A Society of Thoracic Surgery (STS) score for redo AV replacement was 9.7%. An echocardiogram revealed an ejection fraction of 50%, with an AV area of 0.8 cm^2. Resting mean AV gradient was 30 mmHg, which increased to 44 mmHg with dobutamine stress echocardiography. Computerized tomography (CT) revealed a "porcelain aorta" with poor femoral access vessels (4.2 mm right external iliac artery, 5.2 mm left common iliac artery). The valve to right coronary artery distance was 9 mm and valve to left main coronary artery distance was 14.4 mm. The joint cardiac surgery and interventional cardiology heart valve team recommended a valve-in-valve transcatheter AV replacement (VIV TAVR) using bioprosthetic valve fracture (BVF) and transcaval access.

Procedural technique

Preparation

In a recent report of 75 patients undergoing VIV TAVR, there were no cases of coronary occlusion, annular rupture or need for permanent pacemaker insertion (1). With a low risk of catastrophic events during the procedure, general anesthesia is not mandatory. For transcaval access, femoral venous and arterial access are required for snaring to create the inferior vena cava (IVC) to aorta wire access.

Exposition

Planning of VIV TAVR involves consideration of three factors: (I) Examination of the existing bioprosthetic surgical valve; (II) Determination of the size and type of the transcatheter heart valve (THV) to be deployed; (III) Assessment of need for BVF.

The implanted valve size, model and true inner diameter (ID) should be confirmed fluoroscopically. For all porcine valves, the true ID is 2 mm smaller than the listed size (i.e., the stented ID). For pericardial valves, the true ID is 1 mm smaller than the stented ID if the leaflets are mounted inside the stent, and equal to the stented ID if the leaflets are mounted outside the stent (2). We recommend use of a VIV app, which integrates a vast amount of material and provides safe sizing information.

With regard to BVF, the following aortic bioprostheses have been shown to tolerate fracture: St Jude Epic (St. Jude Medical Inc., Minneapolis, MN), Medtronic Mosaic (Medtronic, Minneapolis, MN), Sorin Mitroflow (Sorin Group, Arvada, CO) and Edwards Magna and MagnaEase (Edwards LifeSciences, Irvine, CA). Traditionally the balloon was sized 1mm larger than the true ID of the valve. As published by Allen *et al.*, an alternate method is to size the valve 3–4 mm larger than the true ID. Their results published in 2019 showed a lower mean gradient when sizing the balloon a minimum of 3 mm above the true ID, and we have adopted this method in our practice (1).

Operation

An 8 French (Fr) femoral arterial access and a 6 Fr

contralateral femoral venous access is obtained with Perclose ProGlide (Abbott Vascular Inc., Santa Clara, CA) placed for pre-closure. Abdominal aortography is performed via the arterial access. A gooseneck snare is positioned in the abdominal aorta, and an inferior mesenteric artery catheter is advanced to L2/L3. Fluoroscopy is performed at 90 degrees (left anterior oblique) to align the catheter in the IVC with the gooseneck snare in the aorta. At 0 degrees (anterior-posterior) the Confianza guidewire (Asahi Intecc, Irvine, CA) is advanced and, with 50 Watts electrocautery in cutting mode, a small perforation is made in the IVC then the aorta. The wire is advanced into the aorta and snared. The Finecross microcatheter (Terumo Corporation, Somerset, NJ) is advanced over the wire, which is exchanged for a 0.035" Amplatz superstiff wire, creating a rail from the right femoral vein to the aorta. The venous sheath is exchanged for a 14 Fr eSheath, and therapeutic anticoagulation is verified. A pigtail catheter is then advanced to the aortic root. The valve is crossed and over a stiff wire in the left ventricle, a 23 mm Edwards Sapien S3 valve is advanced. The neoannular plane is identified as the sewing ring of the existing Magna valve and confirmed with aortography. The valve is deployed under rapid pacing. Transesophageal echocardiography (TEE) in this case showed a residual gradient (mean 12 mmHg). A 22 mm True Dilation balloon (Bard Vascular Inc., Tempe, AZ) was advanced and inflated to 18 ATM to fracture the underlying surgical valve. Following BVF, TEE interrogation confirmed a well seated valve with a mean gradient of 5 mmHg. Transcaval closure was successful using a 10/8 Amplatzer ductal occluder. Aortography showed small residual leak and a 12 mm Mustang balloon was inflated at low pressure in the aorta, with good result.

Completion

Transthoracic echocardiography is performed on post-operative day one, at one month follow up and every six months subsequently.

Comments

Clinical results and advantages

There remain tradeoffs in pursuing a transcatheter procedure over a surgical one. Firstly, one year mortality after VIV TAVR remains high, with data from the International VIV Registry showing 28.4% of patients had post operative mean gradients >20 mmHg, which is associated with increased one-year mortality (3). Extrapolation from the PARTNER-2 trial suggests patients with gradients >20 mmHg have a one-year mortality of 16.7% *vs.* 7.7% in those with gradients <20 mmHg (4). Hemodynamics following VIV TAVR versus reoperation tend to be worse and the literature shows this affects one-year outcomes. Second, VIV TAVR alone does not overcome patient prosthesis mismatch (PPM). While BVF has been shown to enlarge the neoannulus by approximately 3 mm, "shoe horning" a larger THV into the annulus has not shown better outcomes and can instead distort the valve (1). In other words, existing PPM may not be treatable with VIV TAVR. Finally, bioprosthetic AV replacement has an expected durability of 10–15 years, while that of VIV TAVR remains unknown. There are small but considerable risks inherent to VIV TAVR. Risk of malpositioning is approximately 1–3% and relates to the experience of the operator, and coronary obstruction occurs in up to 3.5% of cases (3).

Caveats

Long-term viability of VIV TAVR has not been studied. Use of VIV TAVR even with the best technique, including BVF, may not be sufficient to overcome PPM.

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Footnote

Conflicts of Interest: Dr. Nguyen is a consultant for Edwards Life Sciences and LivaNova PLC. Dr. Mahadevan is a proctor for Edwards Life Sciences transcatheter valves and PI for multiple clinical trials on behalf of Edwards Life Sciences, Abbott, and W.L. Gore & Associates, Inc. The other authors have no conflicts of interest to declare.

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