JACC: CASE REPORTS VOL. 3, NO. 6, 2021

EDITORIAL COMMENT

Expanding Bioprosthetic Ring Fracture Indications

Cracking the Walls Will Tear the House Down?*

Danny Dvir, MD,[a] Emanuel Harari, MD[a,b]

Bioprosthetic valves are increasingly being used. This trend, together with increasing longevity and decreasing age in which these valves are being implanted, increase the occurrence of bioprosthetic structural valve degeneration (SVD) (1). SVD of surgically implanted bioprosthetic valves is occasionally a challenging clinical condition because a re-do open heart surgery is commonly considered high risk, especially in patients with significant comorbid conditions (2). Therefore, transcatheter valve replacement (TAVR) in a surgical implanted degenerated valve (valve-in-valve [ViV]) is becoming the default treatment for patients in whom surgically implanted tissue valves have failed. However, small diameter surgical valves impose an additional problem, related to prosthesis–patient mismatch (PPM) (3). A traditional transcatheter heart valve can further reduce the effective orifice area ("Russian-doll" effect) and increase the risk for PPM. Bioprosthetic valve fracturing (BVF) is a technique in which a noncompliant balloon is inflated, before or after the TAVR, inside the surgical valve and at high pressure, to crack the valve frame (4). BVF reduces the risk of residual stenosis after a ViV procedure and occasionally enables implantation of bigger valves with better hemodynamics. It may also reduce paravalvular regurgitation of the original valve. Bench testing and registry data have shown that most bioprosthetic valve rings can be fractured safely with significant improvement in the effective orifice area and with a reasonably low complication rate (5,6). Nevertheless, severe complications of BVF have been described and include damage to the newly implanted TAVR valve (following post-TAVR BVF), as well as hemodynamic instability (following pre-TAVR BVF) in addition to rare mechanical complications (e.g., coronary obstruction, annular injury, and ventricular septal defects). It is clear that although BVF is an effective tool to prevent PPM after a ViV procedure, there are potential serious adverse events.

In this issue of *JACC: Case Reports*, Petrov et al. (7) describe an older adult patient who had a Mitroflow #21 (LivaNova Group Inc., Vancouver, Canada) aortic valve replacement 12 years before. In this type of valve, the leaflet extends outward in a tubular fashion a bit above the surgical device frame. Due to these properties Mitroflow valves pose an increased risk for coronary obstruction (8,9). This particular valve is also small and associated with a high risk of PPM, although the patient did not have residual stenosis. The patient had severe aortic regurgitation. They described severe paravalvular leakage that spanned approximately 75% of the valve circumference. There was a natural concern of dehiscence of the surgically implanted valve. Patients with these kinds of pathologies are conventionally treated with re-do surgery, but this is not safe in high-risk octagenerians. Paravalvular leak closure with an occluder device inside such a wide leak is not favorable as well. BVF was chosen to crack and enlarge the surgical valve ring so that the paravalvular space would be eliminated after TAVR implantation.

*Editorials published in the *JACC: Case Reports* reflect the views of the authors and do not necessarily represent the views of *JACC: Case Reports* or the American College of Cardiology.

From the [a]Jesselson Integrated Heart Center, Shaare Zedek Medical Centre, Hebrew University, Jerusalem, Israel; and the [b]Department of Cardiology, Assuta Ashdod University Hospital, Ben-Gurion University, Beersheba, Israel.

The authors attest they are in compliance with human studies committees and animal welfare regulations of the authors' institutions and Food and Drug Administration guidelines, including patient consent where appropriate. For more information, visit the Author Center.

ISSN 2666-0849 https://doi.org/10.1016/j.jaccas.2021.03.022

This is an unusual application of BVF, and the investigators should be congratulated for using this approach in such a complex patient, and especially, for having a great clinical outcome. In this particular case, BVF followed by implantation of a self-expandable valve diminished the paravalvular regurgitation and improved patient symptoms. Traditionally, BVF is quite predictable, as was shown in bench testing; however, for the purpose of reducing paravalvular leakage in a case with valve dehiscence using BVF is unpredictable. The interaction between the valve and its surroundings with the high radial force might cause embolization of the surgical valve and annular injury. An embolized dehisced surgically implanted valve during the ViV procedure is a life-threatening complication. There is no easy transcatheter solution for this scenario, and these patients may become severely unstable. Therefore, we believe that BVF is risky when applied to dehisced valves. Nevertheless, clinical conditions occasionally drive us to use extreme measures during the care for our frail, older adult patients who are considered inoperable. It is also clear that the exact indications for the need to perform BVF in more conventional clinical conditions (prevention of residual stenosis of small surgically implanted bioprosthetic valves) is still lacking. Further research and modeling are needed to evaluate the safety of BVF and the exact patient population that will improve clinically with this approach.

FUNDING SUPPORT AND AUTHOR DISCLOSURES

Dr. Dvir has been a consultant for Edwards Lifesciences, Medtronic, and Abbott. Dr. Harari has reported that he has no relationships relevant to the contents of this paper to disclose.

ADDRESS FOR CORRESPONDENCE: Dr. Danny Dvir, Division of Cardiology, University of Washington, 1959 Northeast Pacific Street, Seattle, Washington 98195, USA. E-mail: danny.dvir@gmail.com.

REFERENCES

1. Dvir D, Bourguignon T, Otto CM, et al. Standardized definition of structural valve degeneration for surgical and transcatheter bioprosthetic aortic valves. Circulation 2018;137:388–99.

2. Deharo P, Bisson A, Herbert J, et al. Transcatheter valve-in-valve aortic valve replacement as an alternative to surgical re-replacement. J Am Coll Cardiol 2020;76:489–99.

3. Herrmann HC, Daneshvar SA, Fonarow GC, et al. Prosthesis-patient mismatch in patients undergoing transcatheter aortic valve replacement: from the STS/ACC TVT Registry. J Am Coll Cardiol 2018;72:2701–11.

4. Tanase D, Grohmann J, Schubert S, Uhlemann F, Eicken A, Ewert P. Cracking the ring of Edwards Perimount bioprosthesis with ultrahigh pressure balloons prior to transcatheter valve in valve implantation. Int J Cardiol 2014;176:1048–9.

5. Sathananthan J, Sellers S, Barlow AM, et al. Valve-in-valve transcatheter aortic valve replacement and bioprosthetic valve fracture comparing different transcatheter heart valve designs: an ex vivo bench study. J Am Coll Cardiol Intv 2019;12:65–75.

6. Allen KB, Chhatriwalla AK, Saxon JT, et al. Bioprosthetic valve fracture: technical insights from a multicenter study. J Thorac Cardiovasc Surg 2019;158:1317–1328 e1.

7. Petrov IS, Stankov ZI, Boychev DB. Valve cracking before valve-in-valve transcatheter aortic valve implantation to treat severe paravalvular leak. J Am Coll Cardiol Case Rep 2021;3:875–81.

8. Ribeiro HB, Rodes-Cabau J, Blanke P, et al. Incidence, predictors, and clinical outcomes of coronary obstruction following transcatheter aortic valve replacement for degenerative bioprosthetic surgical valves: insights from the VIVID registry. Eur Heart J 2018;39:687–95.

9. Khan JM, Dvir D, Greenbaum AB, et al. Transcatheter laceration of aortic leaflets to prevent coronary obstruction during transcatheter aortic valve replacement: concept to first-in-human. J Am Coll Cardiol Intv 2018;11:677–89.

KEY WORDS aortic valve, chronic heart failure, computed tomography, coronary vessel anomaly, treatment, valve replacement