Acta Cardiol Sin 2022;38:642–645
Letter to the Editor
doi: 10.6515/ACS.202209_38(5).20220330C

Ascending Aorta Pseudoaneurysm as a Rare, Late Complication after Valve-in-Valve Transcatheter Aortic Valve Implantation Procedure

Veronika Vejtasova, Jiri Bonaventura, Robert Topalo and Josef Veselka

INTRODUCTION

First performed in 2002,[1] transcatheter aortic valve implantation (TAVI) offers a suitable and safe option of an aortic valve replacement for patients with high surgical risk. Since 2007, valve-in-valve TAVI (ViV TAVI) procedure is performed on patients who underwent surgical aortic valve replacement (SAVR) in the past, but are in need of having their previously implanted bioprosthetic valve replaced again.[2] The PARTNER 2 trial showed relatively low mortality, substantial improvement of hemodynamic outcome (both pressure gradient and rate of regurgitation) and increase in quality of life three years after ViV TAVI for failed surgically implanted bioprosthesis.[3] A large retrospective study comparing outcomes after redo SAVR and ViV TAVI using propensity matching showed lower in-hospital mortality in ViV TAVI patients and comparable all-cause mortality in 30 days and 6 months follow-up between both groups. The incidence of major adverse cardiovascular events and need of a new pacemaker implantation did not statistically significantly differ between the groups.[4] Neverthless, there are complications that might emerge during or after the procedure. We report a unique case of ascending aorta pseudoaneurysm after TAVI valve-in-valve procedure.

CASE PRESENTATION

73-year-old male patient with an extensive cardiac history was admitted into a tertiary cardiovascular center for progression of dyspnea. Patient's comorbidities included type II diabetes, chronic obstructive pulmonary disease, atrial fibrillation, dyslipidemia, and previously extirpated renal tumor. During the initial exam, the patient reported he had chills and also recorded fever one week prior to the admission, he was fatigued, and developed diarrhea. He did not report any chest pains, syncope, or palpitations. The physical examination revealed a systolic murmur audible over precordium. No other abnormalities were apparent.

The patient underwent SAVR with a bioprosthetic valve (Mitroflow N.23, Sorin Group USA Inc, Arvada, Colorado) due to severe aortic stenosis in 2012, along with a coronary artery bypass graft of the right coronary artery. In February 2019, the aortic bioprosthesis needed to be replaced as a result of severe restenosis (peak/mean pressure gradient 66/41 mmHg, aortic valve area 0.4 cm^2). Due to high surgical risk [Society of Transthoracic Surgeons (STS) score 10.5%], ViV TAVI was recommended and ultimately performed. Acurate S valve (Boston Scientific, Marlborough, Massachusetts) was implanted. There were no complications during, or immediately after the ViV TAVI procedure. Four days after the procedure, transthoracic echocardiography showed optimal results with peak/mean pressure gradient 26/18 mmHg and a mild paraprosthetic regurgitation on the aortic valve.

In November 2020, the patient was admitted for suspicion of infective endocarditis. Collected blood cultures came back positive for Enterococcus faecalis. However, transesophageal echocardiography didn't reveal any visible vegetations or newly developed valvular regurgitation. When applying current Duke criteria for diagnosing infective endocarditis (IE), IE could not be verified. Magnetic resonance imaging scan of the spine showed spondylodiscitis, which was subsequently treated

Received: January 5, 2022 Accepted: March 30, 2022
Department of Cardiology, Motol University Hospital, Prague, Czech Republic.
Corresponding author: Dr. Veronika Vejtasova, Department of Cardiology, Motol University Hospital, V Uvalu 84/1, 150 06 Prague, Czech Republic. Tel: +420 702 269 192; Fax: +420 224 434 920; E-mail: veronika.vejtasova@fnmotol.cz

by antibiotics and the patient was discharged from the hospital.

In May 2021, the patient was readmitted to the tertiary cardiovascular center for suspicion of IE again. Transthoracic and transesophageal echocardiography revealed good systolic function of the left ventricle, with no regional wall motion abnormalities. However, there was a significant progression of intraprosthetic regurgitation on the aortic bioprosthesis with only mild paravalvular leak. There were also two fluttering formations on the leaflets of the bioprosthetic valve seen on the echocardiogram. Laboratory results revealed moderately elevated C-reactive protein (48.6 mg/L) without leukocytosis. Blood cultures were again positive for Enterococcus faecalis. Treatment with a combination of two different antibiotics (ampicillin/sulbactam and gentamicin) was initiated.

Computed tomography (CT) scan of the heart and the ascending aorta was used to display the bioprosthesis in detail. IE could not be verified according to the CT scan. However, there was a visible protrusion of the supraannular part of the bioprosthesis through the wall of the ascending aorta causing a pseudoaneurysm (Figure 1).

In collaboration with the Heart Team, surgical treatment of the ascending aorta pseudoaneurysm was selected as a treatment plan. The entire procedure was initiated by sternotomy. The pseudoaneurysm appeared to have a stable and thick wall. Subsequently, aortotomy was made at the site of the protrusion and the TAVI bioprosthesis was removed. A rupture of one of the cusps was apparent (Figure 2). Microbiological sample was collected, with panbacterial PCR and microbial cultivation verifying Enterococcus faecalis. Originally degenerated aortic bioprosthesis was removed and replaced with a new one (C-E Perimount Magna Ease No 23, Edwards Lifesciences, Irvine, California). Bovine pericardium patch was used to repair the ascending aorta. Twenty-eight days after the surgery, the patient, who was doing well and was symptom free, was discharged from the hospital.

The follow-up transthoracic echocardiographic examination three months after the surgery showed good function of the bioprosthesis with peak/mean pressure

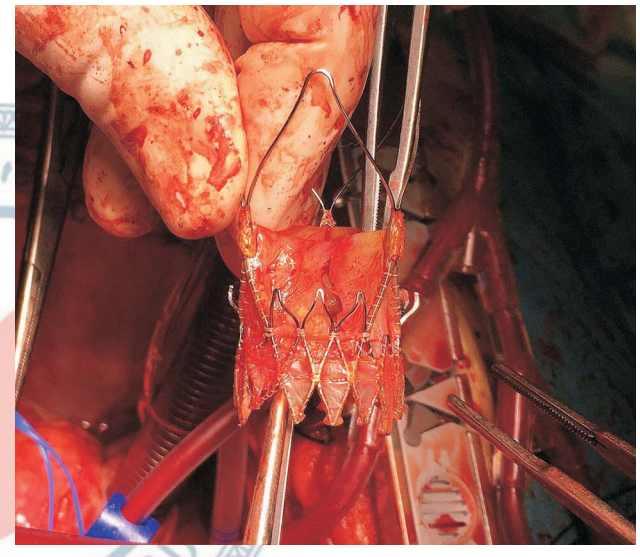

Figure 2. *The aortic bioprosthesis after being removed from the aorta with apparent rupture of one of the cusps.*

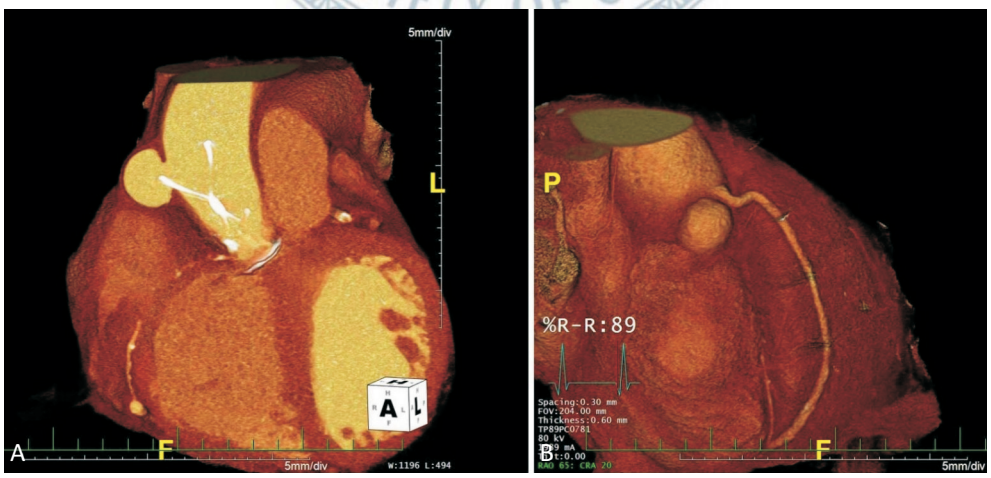

Figure 1. *(A) A cross-sectional view of the computed tomography (CT) reconstruction of ascending aorta pseudoaneurysm, diplaying protrusion of the supraannular part of the bioprosthesis through the wall of the aorta. (B) An external view of the CT reconstruction of ascending aorta pseudoaneurysm and a coronary artery bypass graft of the right coronary artery.*

gradient 19/12 mmHg and no regurgitation. The systolic function of the left ventricle was normal with ejection fraction of 65%. The patient reported mild exertional dyspnea that regressed after intensification of diuretic therapy. There were no other adverse events registered.

DISCUSSION

To our knowledge, there is no published case of the ascending aorta pseudoaneurysm at the site of the self-expanding wire frame after ViV TAVI. There are several mechanisms of how the aortic pseudoaneurysm could have formed. First, the valve could have been placed in such way, in which the supraannular part of the valve was not symmetrically in contact with the wall of the aorta. The asymmetry in pressure placed on the wall could have caused a decubitus ulcer, which eventually led to the wall perforation and development of a pseudoaneurysm. Zucchetta et al. recently published a similar case of an ascending aorta wall ulceration caused directly by an arch of the supraannular frame of the Acurate Neo valve in the native aortic valve position that was affected by IE.[5]

Second, the aortic wall could have been weakened by a mechanical trauma caused by the guide wire while implanting the TAVI prosthesis, which in turn could have led to a development of a pseudoaneurysm. The probability of traumatizing the arterial wall can be lowered by careful wire choice. Pre-shaped wires that better maintain the curved shape of the distal end of the wire are designed to reduce risk of arterial and ventricular injury.[6] Stiffness of the wire also plays an important role – stiffer wires provide greater support and stability, however use of a less stiff wire can reduce the risk of vascular damage and wall perforation.[7]

The pseudoaneurysm could have also been caused by fragility of the aortic wall itself in case of IE. The incidence of IE following TAVI is lower compared to patients after SAVR.[8] Although the rate of IE after TAVI is rather low, it is associated with poor prognosis and high mortality.[8,9] A multicenter study evaluating outcomes of IE after TAVI was published by Amat-Santos et al.[10] The study included 53 patients who were diagnosed with IE following TAVI; the cohort included 7,944 patients during mean follow-up time 1.1 ± 1.2 years (incidence of 0.67%; 0.50% within the first year after TAVI). A pseudoaneurysm was visualized by echocardiography in 2 out of 53 (3.8%) patients. However, no further details were published in this study.[10]

There are several cases of aortic root ruptures causing a pseudoaneurysm. Aminian et al.[11] published a case of late aortic root rupture causing a pseudoaneurysm located between the right ventricle and the right coronary artery visualized on a CT scan 4 months after TAVI procedure.[11] A case of infective endocarditis complicated by an abscess and pseudoaneurysm leading from the left ventricular outflow tract to the anterolateral side of the aorta was published by Pichard,[12] a CT scan was also used to display the post-procedural complication.[12]

LEARNING POINTS

Ascending aorta pseudoaneurysm due to a possible mechanical stress of the supraannular wire frame on the aortic wall is a rare, late complication after valve-in-valve TAVI procedure, which, to our knowledge, has not been reported yet. Our case demonstrates the importance of imaging methods, especially CT scan, in diagnosing post-TAVI procedure complications, as the supraannular portion of the bioprosthesis might not be detected by transthoracic, or even transesophageal echocardiography.

ACKNOWLEDGMENTS

The authors would like to thank MUDr. Michal Polovincak for supplementing the CT reconstruction images.

FUNDING

Supported by MH CZ – DRO, University Hospital Motol, Prague, Czech Republic 00064203.

DECLARATION OF CONFLICT OF INTEREST

All the authors declare that they have no competing interests.

REFERENCES

1. Cribier A, Eltchaninoff H, Bash A, et al. Percutaneous transcatheter implantation of an aortic valve prosthesis for calcific aortic stenosis: first human case description. *Circulation* 2002;106: 3006-8.
2. Wenaweser P, Buellesfeld L, Gerckens U, et al. Percutaneous aortic valve replacement for severe aortic regurgitation in degenerated bioprosthesis: the first valve in valve procedure using the Corevalve Revalving system. *Catheter Cardiovasc Interv* 2007;70: 760-4.
3. Webb JG, Murdoch DJ, Alu MC, et al. 3-year outcomes after valve-in-valve transcatheter aortic valve replacement for degenerated bioprostheses: the PARTNER 2 registry. *J Am Coll Cardiol* 2019;73:2647-55.
4. Majmundar M, Doshi R, Kumar A, et al. Valve-in-valve transcatheter aortic valve implantation versus repeat surgical aortic valve replacement in patients with a failed aortic bioprosthesis. *EuroIntervention* 2021;EIJ-D-21-00472.
5. Zucchetta F, Raviola E, Brega C, et al. Acurate neo bioprosthesis in stenotic bicuspid aortic valve developing aortic ulceration and endocarditis. *Cardiovasc Interv* 2021;14:e11-3.
6. Ruparelia N, Prendergast BD. Technical aspects of transcatheter aortic valve implantation (TAVI). In: E-journal of Cardiology Practice. European Society of Cardiology. 2016. https://www.escardio.org/Journals/E-Journal-of-Cardiology-Practice/Volume-14/technical-aspects-of-transcatheter-aortic-valve-implantation-tavi. Accessed 5 Nov 2021.
7. Thangam M, Balan P. Chapter 2: Standard Wires and Balloones Used in TAVR. In: TAVR Handbook. American Colledge of Cardiology. 2018. https://www.acc.org/-/media/Non-Clinical/Files-PDFs-Excel-MS-Word-etc/Membership/TAVR-Handbook/Chapter-2-Standard-wire-and-balloons-used-in-TAVR-March-2-2018.pdf. Accessed 5 Nov 2021.
8. Wang J, Wang X, Hou F, et al. Infective endocarditis after transcatheter versus surgical aortic valve replacement: a meta-analysis. *Angiology* 2020;71:955-65.
9. Mentias A, Girotra S, Desai MY, et al. Incidence, predictors, and outcomes of endocarditis after transcatheter aortic valve replacement in the United States. *Cardiovasc Interv* 2020;13:1973-82.
10. Amat-Santos IJ, Messika-Zeitoun D, Eltchaninoff H, et al. Infective endocarditis after transcatheter aortic valve implantation: results from a large multicenter registry. *Circulation* 2015;131: 1566-74.
11. Aminian A, Lalmand J, Dolatabadi D. Late contained aortic root rupture and ventricular septal defect after transcatheter aortic valve implantation. *Catheter Cardiovasc Interv* 2013;81:72-5.
12. Pichard S, Gibault-Genty G, Vienet-Legue A, et al. Complicated transcatheter aortic-valve endocarditis with abscess and pseudoaneurysm: value of the ECG-gated multidetector computed tomography angiography. *Ann Cardiol Angeiol* 2016;66:338-42.