JACC: CASE REPORTS VOL. 29, 2024

CORONARY, PERIPHERAL, AND STRUCTURAL INTERVENTIONS

CASE REPORT: CLINICAL CASE SERIES

Chronic Total Occlusion of the Left Main and Severe Aortic Stenosis

Silvia Maiani, MD,[a] Francesco Sanna, MD,[b] Alberto Boi, MD,[b] Angelica Rossi, MD,[b] Donovan Riganelli, MD,[b] Luigi Valentino, MD,[c] Gildo Matta, MD,[d] Alessandra Marceddu, MD,[e] Gabriele Pesarini, MD,[f] Flavio Ribichini, MD,[f] Bruno Loi, MD[b]

ABSTRACT

Concomitant aortic stenosis and coronary artery disease in the elderly population is frequent and the proper therapeutic approach is a matter of debate. We present 2 challenging cases of patients affected by severe aortic stenosis and chronic total occlusion of the left main, demonstrating the safety and feasibility of transcatheter aortic valve replacement, performed both with balloon-expandable and self-expanding valves. (JACC Case Rep 2024;29:102433)

Aortic stenosis (AS) is the most prevalent valvular disease in the developed world and is frequently associated with coronary artery disease (CAD).[1] Transcatheter aortic valve replacement (TAVR) has emerged as the preferred interventional strategy for elderly patients, irrespective of surgical risk.[2] The prevalence of concomitant AS and CAD in the elderly population ranges from 50% to 75%, but in recent randomized controlled trials (RCTs) it decreased along with the progressive reduction in mean age and mean surgical risk of enrolled patients.[3] The role and the timing of revascularization in this complex setting is a matter of debate. We present 2 challenging cases of patients affected by severe AS and chronic total occlusion (CTO) of the left main (LM) coronary artery.

LEARNING OBJECTIVES

- To be able to plan a patient-tailored approach, considering patient comorbidities and the challenging procedure.
- To understand the role of LM CTO in complex scenarios and to evaluate the risk/benefit ratio of revascularization before TAVR.

CASE PRESENTATION

CASE 1. An 81-year-old man with chronic coronary disease, end-stage chronic kidney disease in hemodialysis, permanent atrial fibrillation in oral anticoagulation, arterial hypertension, and carotid stenosis was diagnosed as having severe AS. He was symptomatic for dyspnea (NYHA class II). Transthoracic echocardiography (TTE) showed a hypertrophic left ventricle and moderate left ventricular dysfunction (ejection fraction [EF]: 40%), with diffuse hypokinesis; the aortic valve appeared severely calcified with a mean aortic gradient of

From the [a]Clinical Cardiology, Department of Medical Science and Public Health, University of Cagliari, Monserrato, Italy; [b]Department of Interventional Cardiology, G. Brotzu Hospital, Cagliari, Italy; [c]Department of Cardiology, G. Brotzu Hospital, Cagliari, Italy; [d]Department of Radiology, G. Brotzu Hospital, Cagliari, Italy; [e]Cardioanaesthesia and Cardiosurgical Intensive Care Unit, Cardiovascular Department, G. Brotzu Hospital, Cagliari, Italy; and the [f]Division of Cardiology, Department of Medicine, University of Verona, Verona, Italy.

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.

Manuscript received March 6, 2024; revised manuscript received April 8, 2024, accepted April 11, 2024.

ISSN 2666-0849 https://doi.org/10.1016/j.jaccas.2024.102433

ABBREVIATIONS AND ACRONYMS

AS = aortic stenosis

CAD = coronary artery disease

CTO = chronic total occlusion

EF = ejection fraction

LM = left main

PCI = percutaneous coronary intervention

RCT = randomized controlled trial

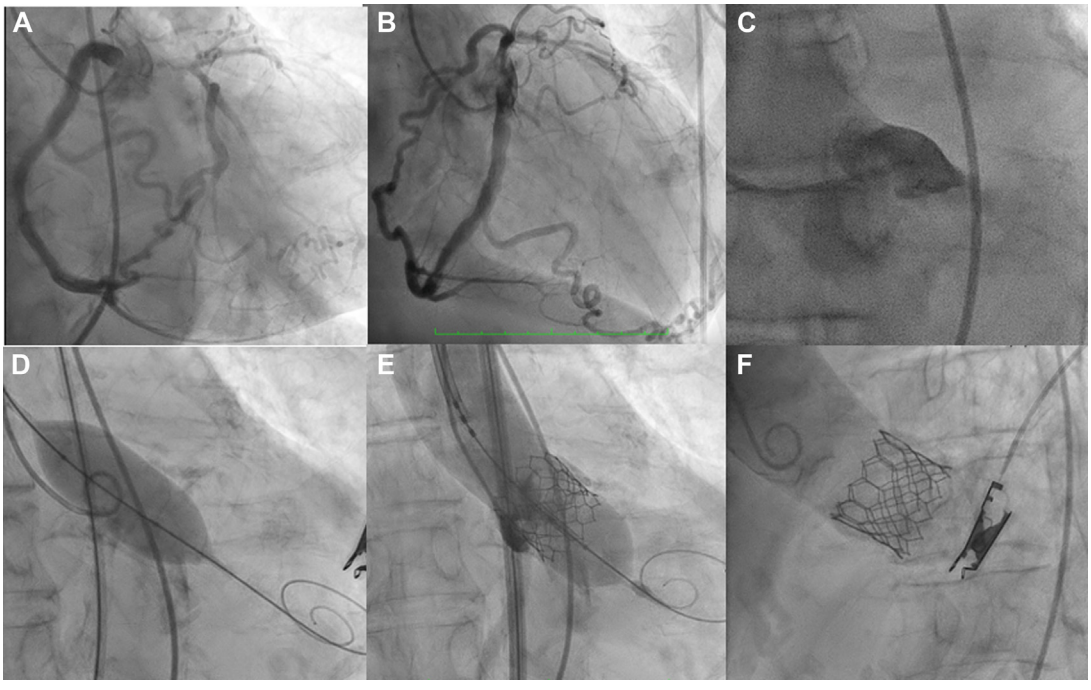
TAVR = transcatheter aortic valve replacement

THV = transcatheter heart valve

TTE = transthoracic echocardiography

70 mm Hg, a peak aortic velocity of 5.3 m/s, with an aortic valve area of 0.5 cm^2. He underwent standard computed tomography angiography-based preprocedural planning. Considering his Society of Thoracic Surgeons score of 24% and comorbidities, the Heart Team referred him to TAVR. Preprocedural coronary angiography demonstrated a CTO of the LM supplied from a well-developed collateral vessel from the right coronary artery. Considering the challenging scenario and the high-risk patient profile, we decided to postpone the procedure to reassess the different therapeutic options. A few weeks later, he was admitted to our Department due to acute decompensated heart failure and syncope. At admission, clinical examination revealed systemic congestion. The electrocardiogram showed high-frequency atrial fibrillation with diffuse repolarization abnormalities. Laboratory tests indicated elevated N-terminal pro-B-type natriuretic peptide value (4,318 pg/mL. normal value <100 pg/mL), without significant cardiac enzyme elevation. TTE showed worsened left ventricular dysfunction, with an EF of 15%. A new Heart Team discussion was set up and we decided for TAVR in conscious sedation, via the right femoral artery, without prior coronary revascularization. After clinical and hemodynamic stabilization, he underwent a balloon-expandable Sapien 3 Ultra 29 mm (Edwards Lifesciences) valve implantation during high-frequency intraventricular pacing (180 beats/min), previously a balloon valvuloplasty (25 × 50 mm VACS II, Osypka Medical) (Figure 1). The final aortogram demonstrated no right coronary obstruction or paravalvular leak. The patient was transferred to our Intensive Care Unit for monitoring and rapidly improved his clinical condition. Seriate TTE demonstrated a significant improvement in left ventricular systolic function (up to an EF of 50%). A few days later, the patient developed a complete atrioventricular block and a leadless pacemaker was implanted, with no

FIGURE 1 Step-by-Step Procedure



(A to C) Dominant right coronary artery with good collaterals to the left and occlusion of the left main (LM); (D) balloon valvuloplasty with 25 × 50 mm VACS II ballon; (E) balloon expandable Sapien 3 Ultra 29 mm transcatheter heart valve (THV) implantation in 3-cusp view; (F) final angiographic result.

complications. He was discharged 10 days after the index procedure, hemodynamically stable, with recommendation to oral anticoagulation. Our patient is asymptomatic at 6-month clinical follow-up.

CASE 2. An 86-year-old woman had chronic kidney disease (stage IIIb), frailty, and severe AS symptomatic for angina. She was admitted for acute heart failure, angina, and dyspnea (NYHA class III). TTE showed a hypertrophic left ventricle, severe left ventricular dysfunction (EF: 30%); her aortic valve appeared severely calcified with a mean aortic gradient of 48 mm Hg, a peak aortic velocity of 4.9 m/s, with an aortic valve area of 0.43 cm^2. Laboratory tests demonstrated a mild anemia with hemoglobin value of 10.2 g/dL (normal value 12-16 g/dL), reduced glomerular filtration rate (38 mL/min/m^2), and no altered cardiac enzymes. Preprocedural coronary angiography demonstrated a CTO of the LM and a dominant right coronary artery with mild collaterals to the left coronary artery. Her Society of Thoracic Surgeons score was 7.5%. After Heart Team discussion, she underwent a self-expandable, supra-annular, Evolut R 29-mm (Medtronic) transfemoral valve implantation under conscious sedation. The final aortogram demonstrated no right coronary obstruction or paravalvular leak. She was started on single antiplatelet therapy, with aspirin. The patient was followed up with seriate TTE demonstrating a significant improvement in left ventricular systolic function, with complete recovery at 2 months. Seven years of clinical follow-up was uneventful and she was asymptomatic for angina. She died at the age of 94 years, due to a noncardiovascular event.

DISCUSSION

The association of severe AS and CAD in a single patient is frequent in clinical practice, suggesting a common etiopathological pathway.[1] The appropriate procedural strategy should be patient-tailored, particularly in complex scenarios such as our cases. Actually, TAVR is the established interventional strategy for elderly patients with severe AS, but there is limited evidence regarding the role and the optimal timing of percutaneous coronary intervention (PCI) in patients undergoing a transcatheter heart valve (THV) implantation. European Society of Cardiology guidelines on valvular heart disease[2] strongly recommend a coronary artery bypass grafting during surgical aortic valve replacement in patients affected by concomitant severe AS and CAD who are suitable for a surgical approach. Because large RCTs have not deeply investigated the effect of PCI in TAVR patients in terms of hard endpoints, its role is actually debated. Recent studies demonstrated that PCI after TAVR seems to be associated with improved 2-year clinical outcomes[4] and that performing TAVR first in patients with concomitant, stable obstructive CAD is a safe option and PCI could be considered post-TAVR, in case of residual symptoms despite optimal medical therapy.[5] To the best of our knowledge, this is the first report describing TAVR performed in patients with CTO of the LM trunk. The use of both balloon-expandable and supra-annular self-expandable valves was safe and effective in 2 cases, without any specific preventive measure during the implantation, suggesting that either the rapid pacing or the slow self-deployment of the valve have no impact in this setting. The type of THV was chosen according to the calcium distribution and the anatomy of the aortic root and the left ventricular outflow tract. Large RCTs have not thoroughly investigated the implications between AS and complex CAD with coronary CTOs. In the literature, occurrence of a CTO in the TAVR population ranges from 2.0%-12.6% and it is associated with adverse outcomes. A recent meta-analysis[6] confirmed the greater risk for in-hospital cardiogenic shock, acute myocardial infarction, acute kidney injury, and longer hospitalization of patients with CTO undergoing TAVR, but without increased in-hospital mortality. Further studies are needed to confirm the results and to investigate the appropriate time and recommendation for revascularization. In general, a LM CTO is an infrequent finding and PCI is infrequently performed (0.45% of all CTO-PCI cases mainly in prior coronary artery bypass grafting patients).[7] Both our patients presented a LM CTO recanalized by a collateral circle fully patent from the right coronary artery. Despite the presence of such a severe CAD, they were not taking anti-ischemic therapy, but only diuretic and antihypertensive therapy, and they did not present significant elevation of cardiac enzymes at hospital admission, in a setting of severe heart failure, associated with high-frequency atrial fibrillation in the first case. For these reasons, we attributed the predominant role in determining their clinical presentation to the presence of severe AS. Being aware of the high ischemic burden associated with a LM CTO, we decided to approach it conservatively and re-evaluate the indication to PCI after TAVR. Indeed, the percutaneous revascularization of such a complex CAD, combined with our patients comorbidities, entails a very high risk of complications and procedural failure, which does not justify the risk of pursuing a percutaneous approach and leans toward a conservative approach

instead, particularly in elderly patients and in the absence of severe residual angina after TAVR.

CONCLUSIONS

CAD is commonly associated with severe AS in patients undergoing TAVR. Strong evidence about indication and timing of revascularization is lacking. Further studies are needed to establish the proper combined approach to CAD and AS, which should be patient-tailored, particularly in challenging scenarios. Total occlusion of the LM causes a large ischemic burden and is associated with adverse outcomes, due to the increased procedural risk. These 2 cases show the safety and feasibility of implanting, either, balloon-expandable or supra-annular self-expanding THV in TAVR candidates with CTO of the unprotected LM trunk. According to our experience, percutaneous revascularization not represents the primary therapeutic target and CAD could be managed with optimal medical treatment, reassessing the indication to PCI in case of symptom persistence after TAVR.

FUNDING SUPPORT AND AUTHOR DISCLOSURES

Prof Flavio Ribichini is a physician proctor for Medtronic and Edwards Lifesciences. All other authors have reported that they have no relationships relevant to the contents of this paper to disclose.

ADDRESS FOR CORRESPONDENCE: Dr Silvia Maiani, University of Cagliari, SS554, 4, Monserrato, CA 09042, Italy. E-mail: silvia.maiani@gmail.com.

REFERENCES

1. Stewart BF, Siscovick D, Lind BK, et al. Clinical factors associated with calcific aortic valve disease. Cardiovascular Health Study. *J Am Coll Cardiol*. 1997;29:630–634.

2. Vahanian A, Beyersdorf F, Praz F, et al, ESC/EACTS Scientific Document Group. 2021 ESC/EACTS Guidelines for the management of valvular heart disease. *Eur Heart J*. 2022;43:561–632.

3. Faroux L, Guimaraes L, Wintzer-Wehekind J, et al. Coronary artery disease and transcatheter aortic valve replacement: *JACC* State-of-the-Art Review. *J Am Coll Cardiol*. 2019;74:362–372.

4. Rheude T, Costa G, Ribichini FL, Pilgrim T, et al. Comparison of different percutaneous revascularisation timing strategies in patients undergoing transcatheter aortic valve implantation. *EuroIntervention*. 2023;19:589–599.

5. Persits I, Layoun H, Kondoleon NP, et al. Impact of untreated chronic obstructive coronary artery disease on outcomes after transcatheter aortic valve replacement. *Eur Heart J*. 2024;45:1890–1900.

6. Will M, Schwarz K, Weiss T, et al. The impact of chronic total occlusions in patients undergoing transcatheter aortic valve replacement: a systematic review and meta-analysis. *Catheter Cardiovasc Interv*. 2023;101:806–812.

7. Winter MP, Goliasch G, Bartko P, et al. Left main coronary artery disease and outcomes after percutaneous coronary intervention for chronic total occlusions. *J Clin Med*. 2020;9:938.

KEY WORDS aortic stenosis, chronic total occlusion, coronary artery disease, left main, transcatheter heart valve implantation