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Case report

Simultaneous percutaneous coronary intervention and transcatheter aortic valve implantation in a very high-risk octogenarian patient – What's ideal time?

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ABSTRACT

Transcatheter Aortic Valve Implantation (TAVI) is a well-established procedure for patients with symptomatic aortic stenosis, particularly for those patients who a high risk with conventional surgical aortic valve replacement. However, some patients are high risk for TAVI secondary to severe left ventricular dysfunction and significant coronary artery disease. We report a high-risk TAVI patient who was successfully treated with simultaneous percutaneous coronary intervention. In this high-risk TAVI procedure, percutaneously coronary intervention improved the success of the procedure, maintained hemodynamic stability throughout the procedure and reduced the periprocedural complications.

Introduction

There is no established protocol for how and when to treat coronary artery disease (CAD) for patients referred to for Transcatheter aortic valve implantation (TAVI). Coronary artery disease (CAD) is observed in 60–70% of TAVR patients.[1] Percutaneous coronary intervention (PCI) is a treatment choice for CADs. This can be achieved in a double-stage process, before or after the TAVI process. The theoretical solution is that both pathologies are handled simultaneously. There is also a shortage of evidence on a single process, integrated approach in a larger patient population and only anecdotal clinical studies exists.[2,3] (see Figs. 1–3)

We record our initial clinical experience with a single-stage approach (combined PCI and TAVI) for the treatment of severe aortic valve stenosis and CAD in a very high-risk patient.

Case report

The 81-years-African male admitted with complaints of the progressive shortness of breath New York heart association class III on exertion for 3 months. He complained of the paroxysmal nocturnal dyspnoea along with swelling of the lower limbs for the past 1 month. He underwent PCI to the right coronary artery in 1999.

He consulted a local cardiologist who performed echocardiography that revealed the presence of severe left ventricular dysfunction with severe calcific aortic stenosis. STS score was high hence he was suggested for trans-catheter aortic valve replacement [TAVR]. He travelled to India for getting advance interventional therapy.

Vital parameters recorded were pulse rate 68/minute, blood pressure of 110/70 mm Hg. He weighed 65 Kg and height of 174 cm [BMI-21.47 kg/m2]. Clinical examination revealed pitting bilateral pedal oedema and on auscultation, there was ejection systolic murmur grade III/VI radiating to both carotids. On admission, we performed routine laboratory investigations which normal except serum creatinine of 1.3 mg% [eGFR – 41 ml/min].

Electrocardiography demonstrated sinus rhythm, left ventricular hypertrophy with strain pattern. Echocardiography showed dilated chambers, global hypokinesia of left ventricle, severe left ventricular dysfunction [EF-28%] with grade III diastolic dysfunction. Doppler interrogation of the aortic valve revealed a high gradient [peak gradient – 74 mm Hg and mean gradient – 37 mm Hg], aortic valve area by continuity equation was 0.9 cm^2. There was a speck of calcium over the aortic cusps. Colour flow mapping of the mitral valve demonstrated moderate mitral regurgitation. There was mild dilatation of right ventricle and mild tricuspid

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regurgitation, a right ventricular systolic pressure of 50 mm Hg.

He was subjected to multislice CT aortic angiography, which confirmed the suitability of TAVR. All parameters were appropriate except that the ostial height of the left coronary artery was 7.9 mm and the right coronary ostial height was 13.3 mm (Fig. 1).

Due to severe renal impairment, it was adequately hydrated in consultation with the nephrologist. After 2 days of adequate hydration, conventional coronary angiography was performed to reduce the amount of contrast. CAG revealed critical stenosis in the middle segment of the left anterior descending artery [LAD]. There was also significant long-segment tandem stenosis in the mid-distal segments of the right coronary artery [RCA].

There is no consensus on the timing of PCI in-patients with severe aortic stenosis who are planning to undergo TAVI. A heart team consisting of a cardiologist, a cardiothoracic surgeon, an interventional radiologist, and a vascular surgeon decided in favour of PCI, followed by a transcatheter aortic valve replacement in the same sitting. The written informed consent was obtained from the family members after all possible complications had been explained to them.

The procedure was performed under general anaesthesia. The left femoral artery and vein were cannulated using 6 Fr. sheaths. PCI

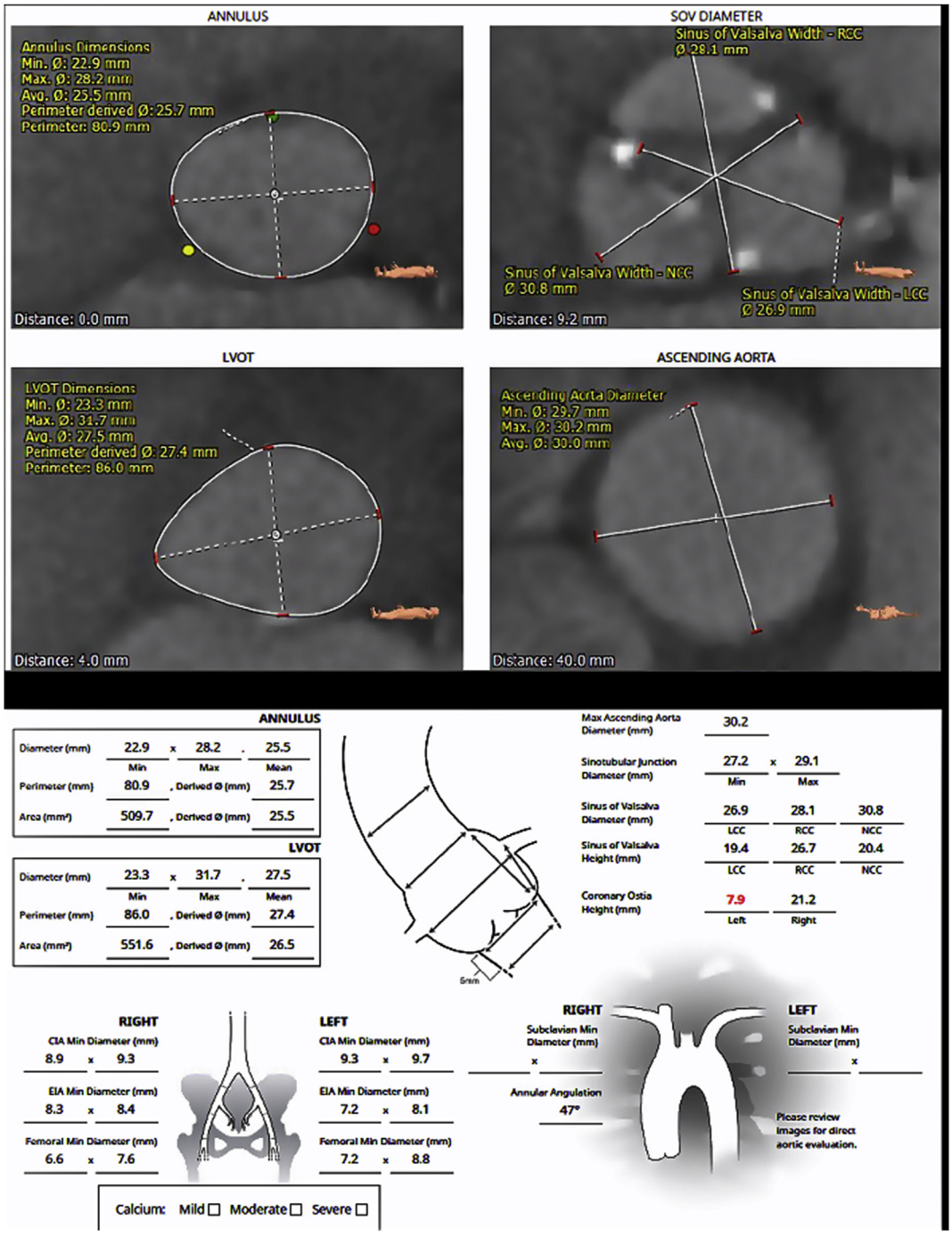

Fig. 1. Showing data obtained from ***preprocedural computed tomography aortography*** showing mean annulus of the aorta was 25.7 mm and calcium was distributed evenly. During the procedure, the height of the left coronary artery was lower which required left coronary artery protection.

to the RCA was done after adequate pre dilatation using a 2.5 mm non-compliant balloon. Two overlapping zotarolimus-eluting stents were deployed at an optimal pressure of 12 atm across the mid-distal segments of the RCA. Left coronary artery angiography showed haziness of the left main coronary artery. The possibility of spontaneous coronary dissection versus calcification was suspected. Optical coherence tomography was performed which did not show any significant stenosis with eccentric calcification. PCI to the mid-segment of the LAD was done using Zotarolimus-eluting stent. There was no residual dissection with TIMI III flow (Fig. 2A-D).

The right femoral artery was cannulated under angiographic guidance injected from the left femoral artery. The higher right femoral artery puncture was done above the femoral bifurcation and initially, 7 Fr. sheath was inserted. Two pro guides at 11 'o and 2 'o clock positions were deployed, and 18 Fr sheath was upgraded using minor surgical techniques.

The aortic valve was crossed using AL 1 catheter and straight tip 0.035 wire. It was exchanged for the pigtail catheter that was removed after the insertion of confida wire (Fig. 3A). The peak-to-peak gradient of 60 mm Hg was measured between LV and aorta. The left coronary artery was protected with a 6Fr EBU guiding catheter and coronary guidewire in the left anterior descending artery, due to the small left coronary height. The guiding catheter was disengaged and kept in the aorta for back up.

Initially, balloon aortic valvuloplasty using a 20 mm Z-med balloon was performed under rapid pacing @ 180 bpm and simultaneous aortic angiography to look for the movements of the left aortic cusp leading to obstruction of the LMCA.

26 mm partially retrievable Evolut-R self-expanding valve was inserted under fluoroscopic guidance (Fig. 3B). The optimal valve position was confirmed with the help of the aortic root angiography and was deployed as per the standard protocol under the rapid pacing @ 160 bpm.

After valve deployment, the aortic root angiography showed a moderate paravalvular leakage, which was then dilated using a 20 mm balloon, which reduced it to a milder severity (Fig. 3C, D). The femoral artery haemostasis was achieved using pre-inserted proglides.

The patient was hemodynamically stable in sinus rhythm and extubated the following day. He was moved to the floor where he was ambulated after 2 days of observation in the ICCU. His serum

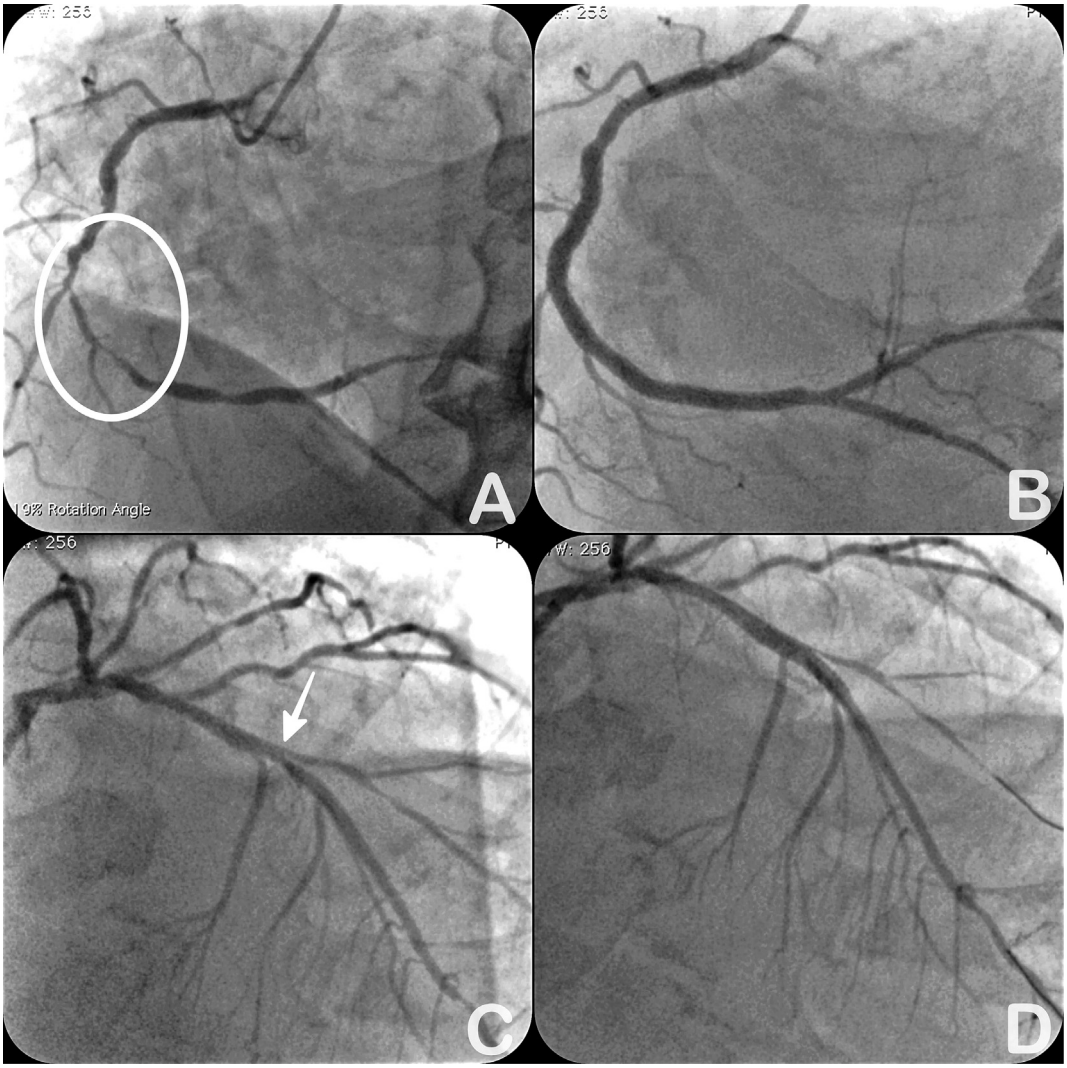

Fig. 2. A-D showing ***percutaneous coronary intervention***. The right coronary artery demonstrated critical tandem long segment stenoses of its mid segment [Panel A] which required deployment of the two overlapping drug eluting stents [Panel B]. The left anterior descending artery revealed stenosis of its mid segment [Panel C] and a DES was implanted across it without any residual stenosis or dissection with TIMI III flow [Panel D].

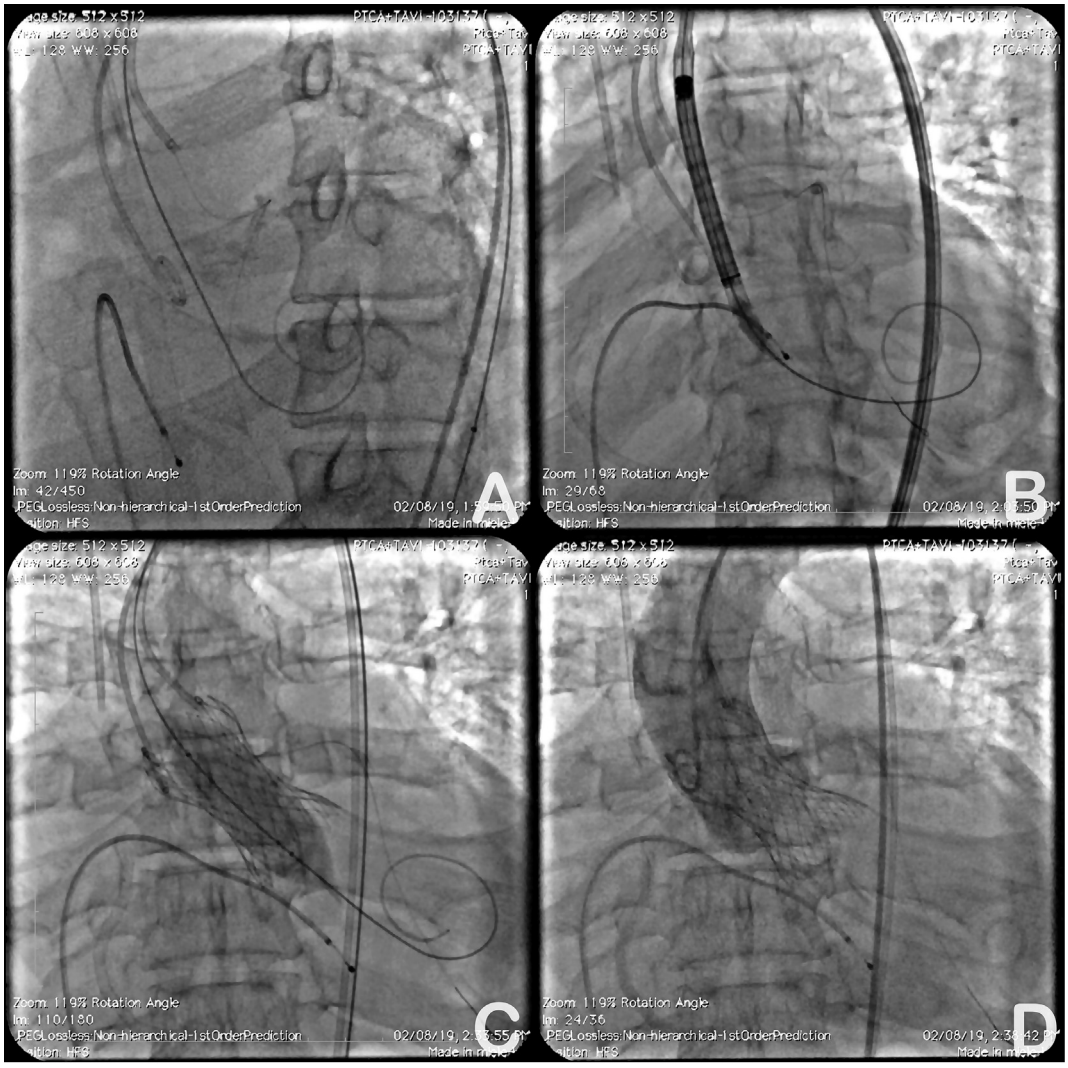

Fig. 3. A-D showing procedure of the ***transcatheter aortic valve replacement***. Left anterior oblique shows various hardwares mounted in the ascending aorta before aortic valve is deployed. Pigtail catheter was installed in the noncoronary aortic cusp, confida wire is seen through the aortic valve in the left ventricle, and balloon tipped pacing wire in the right ventricle. Even, protection of the left coronary artery is achieved using 3.5, 6Fr. EBU guide catheter with guide wire through the LAD [Panel A] Positioning of the 26 mm Evolute-R transcatheter aortic valve across the aortic valve before deployment to ensure optimum position. [Panel B] 20 mm Z-med balloon for post-dilatation to minimize moderate paravalvular leakage. [Panel C] Final aortic root angiography revealed an optimally located aortic transcatheter valve and decreased paravalvular leakage to a mild level. [Panel D].

creatinine increased to 2.7 mg percent and then reached a nadir of 1.4 mg percent before discharge with normal urine output.

He flew back to his home uneventfully and he was in NYHA class I at the end of 8-month follow-up by a local cardiologist.

Discussion

A person with serious aortic stenosis over 80 years or with a Euro SCORE >20% was deemed to have surgical contraindications before the option to implant the valve emerged through peripheral access.[4] While numerous studies in the past have demonstrated that the implementation of the AVR and bypass grafting simultaneously almost doubled mortality. Also, various cardiac surgical series demonstrated that AVR mortality is increased if significant coronary artery stenosis were not addressed. Concurrent coronary artery bypass grafting and surgical valve replacement has now become the standard surgical management in those group of patients who have significant CAD and severe symptomatic AS.[5]

There are few clinical trials in which alternative procedures such as PCI and minimally invasive AVR were attempted on the same day to minimize risk relative to the combined surgical AVR and CABG.[6] Yet at this stage, there were few unknown facts concerning the timing of the PCI either before the operation or at the same time. The prevalence of the associated CAD was estimated by different authors in patients with significant AS was 50–75%. They also provided mixed TAVI outcomes undergoing revascularization for those with CAD.[7–9] Yang et in their meta-analysis showed little difference between the concomitant PCI and TAVR compared with the staged PCI and TAVR.[10] In 2017, another meta-analysis by Kotronias et al. found that coronary revascularization was associated with increased risk of major vascular complications and higher 30-day mortality in a large study involving more than 3000 TAVR patients, but this correlation vanished after 1 year.[11]

The primary objective of combined PCI and TAVI was to avoid myocardial infarction during the intervention at the same time without increasing the intensity of the procedure. Coronary artery stenosis was only considered significant when that artery vascularized a large myocardial region. Left major coronary artery stenosis if more than 50% or 90% or more coronary stenosis found in the proximal or mid-segments of major epicardial stenosis that is

technically compatible with simple PCI. PCI should be able to perform with a very high likelihood of success.[3]

Penkalla et al. reported 730 retrospective cases of transapical TAVI who had significant CAD. They divided them into three groups: no CAD, minimal CAD and significant CAD. 12.8% of patients had a highly severe coronary lesion(s) and underwent combined, single-stage TAVI and PCI. Patients combined TAVI and PCI had comparable survival for up to 3 years as patients without CAD undergoing TAVI only. Though Radiation time and amount of contrast agent were higher during combined treatment, there was no difference in acute kidney injury secondary to contrast nephropathy.[12]

Pasic et al. studied the result of the combined PCI and TAVI in 11% of patients among the 419 patients undergone transapical TAVI. Only patients with significant coronary lesions were treated under this combined approach like in our case. This integrated approach had 100% technological success. The average stent count per patient was 1.6 ± 1.0 (range, 1–5). The combined PCI and TAVI group 30 day-mortality rate was 4.3% and almost 70% survival at the end of 36 months follow -up.[3]

The potential advantage of this concurrent, single-stage method is the complete elimination of future complications from coronary artery disease, such as post-procedural myocardial infarction, which remains untreated if revascularization is not performed with the severe CAD. The single-stage combination approach addresses all pathologies at the same time without the need for more future treatments.[5] Additional possible benefits include better access to the coronaries before TAVR and decreased chances of secondary hemodynamic instability to ischemia due to rapid pacing during the intervention.[13] Besides, an improvement in the New York Heart Association class and the quality of life is the possible advantage of additional PCI. Further, this strategy can also slash operating costs.[14]

The only disadvantages are the increase in the procedure time and contrast load, but they are not significant variables. The position statement by the American College of Cardiology offers some instruction in this regard. The suggestion is that “PCI should be considered before and at the time of TAVR in all patients with significant proximal coronary stenosis in major coronary arteries, and non-proximal lesions that may be symptomatic should be treated with PCI before and re-evaluated by the patient for TAVR at a later time.”[13]

Our patient with <30% ejection fraction, New York Heart Association class III disease and double-vessel coronary artery disease are more likely to experience ischemia-related complications during TAVR. Besides procedural safety, another issue is whether the magnitude of the CAD will affect procedural success and long-term survival, which is why we justify doing PCI and TAVI simultaneously.

Besides, earlier randomized TAVI clinical trials have ruled out patients with severe CADs. The appropriate PCI approach for various clinical situations will evolve from future studies addressing this issue.

Conclusion

For patients with symptomatic significant AS those are inoperable due to serious left ventricular dysfunction and advanced age, TAVI offers the best alternative. We documented a case of TAVI in high-risk anatomy associated with significant coronary artery disease, with low coronary heights. In the Indian setting, with diligent preparation and execution, we overcome these complex anatomical obstacles.

It is possible and practical to treat the most severe coronary artery lesion or PCI lesions at the same time during TAVI. It has become our primary choice in the treatment of high-risk patients with severe aortic valve stenosis and significant CAD. The primary objective of the simultaneous procedure is to prevent postoperative myocardial infarction without increasing the risk of the procedure.

Since the evidence is heterogeneous, there are no consistent guidelines on the correct period between the two treatments, and all cases should be individualized, and treatment should be customized to match every circumstance.

References

1. Lefèvre T, Kappetein AP, Wolner E, et al, PARTNER EU Investigator Group. One year follow-up of the multi- centre European PARTNER transcatheter heart valve study. *Eur Heart J*. 2011;32:148–157.
2. Mostafa AE, Geist V, Abdel-Wahab M. Ad hoc percutaneous coronary intervention and transcatheter aortic valve implantation as a combined transfemoral procedure. *J Invasive Cardiol*. 2011;23:E102–E105.
3. Pasic M, Dreysse S, Unbehaun A, et al. Combined elective percutaneous coronary intervention and transapical transcatheter aortic valve implantation. *Interact Cardiovasc Thorac Surg*. 2012;14(4):463–468.
4. Careaga-Reyna G, Lázaro-Castillo JL, Lezama-Urtecho CA, Macías-Miranda E, Dosta-Herrera JJ, Díaz JG. Transcatheter aortic valve implantation for aortic stenosis [Internet] *Initial Exp Cirugía y Cir*. 2017;85(5):375–380. https://doi.org/10.1016/j.circen.2017.11.014. Available from:.
5. Kodali SK, Moses JW. Coronary artery disease and aortic stenosis in the transcatheter aortic valve replacement era: old questions, new paradigms: the evolving role of percutaneous coronary intervention in the treatment of patients with aortic stenosis. *Circulation*. 2012;125(8):975–977.
6. Brinster DR, Byrne M, Rogers CD, et al. Effectiveness of same day percutaneous coronary intervention followed by minimally invasive aortic valve replacement for aortic stenosis and moderate coronary disease (“hybrid approach”). *Am J Cardiol*. 2006;98(11):1501–1503. https://doi.org/10.1016/j.amjcard.2006.08.010.
7. Dewey TM, Brown DL, Herbert MA, et al. Effect of concomitant coronary artery disease on procedural and late outcomes of transcatheter aortic valve implantation. *Ann Thorac Surg*. 2010;89(3):758–767. https://doi.org/10.1016/j.athoracsur.2009.12.033.
8. Masson JB, Lee M, Boone RH, et al. Impact of coronary artery disease on outcomes after transcatheter aortic valve implantation. *Catheter Cardiovasc Interv*. 2010;76:165–173.
9. Gautier M, Pepin M, Himbert D, et al. Impact of coronary artery disease on indications for transcatheter aortic valve implantation and on procedural outcomes. *EuroInvervention*. 2011;7:549–555.
10. Yang Y, Huang FY, Huang BT, et al. The safety of concomitant transcatheter aortic valve replacement and percutaneous coronary intervention. *Med (United States)*. 2017;96(48):1–6.
11. Kotronias RA, Kwok CS, George S, et al. Transcatheter aortic valve implantation with or without percutaneous coronary artery revascularization strategy: a systematic review and meta-analysis. *J Am Heart Assoc*. 2017;6(6):1–27.
12. Penkalla A, Pasic M, Drews T, et al. Transcatheter aortic valve implantation combined with elective coronary artery stenting: a simultaneous approach. *Eur J Cardio-Thoracic Surg*. 2014;47(6):1083–1089.
13. Aljure OD, Fabbro M. Percutaneous coronary artery revascularization and transcatheter aortic valve replacement: is there a who, why, and when? [Internet] *J Cardiothorac Vasc Anesth*. 2019;33(6):1696–1697. https://doi.org/10.1053/j.jvca.2019.01.013. Available from:.
14. Kappetein AP, Head SJ, Généreux P, et al. Updated standardized endpoint definitions for transcatheter aortic valve implantation: the Valve Academic Research Consortium-2 consensus document (VARC-2). *Eur J Cardiothorac Surg*. 2012;42(5):S45–S60. https://doi.org/10.1093/ejcts/ezs533.