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**CASE REPORT**
*Other*

# Transcatheter aortic valve-in-valve post-dilatation as an overlooked risk factor of delayed coronary obstruction: a case report

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**Background** The risk of coronary obstruction during transcatheter aortic valve-in-valve replacement (VIV-TAVR) in patients deemed at high risk for surgical re-intervention is still a concerning issue.

**Case summary** A 78-year-old woman with a past medical history of hypertension, chronic kidney disease, and rheumatoid arthritis was referred for a symptomatic and severely stenotic surgical Mitroflow n.21 bio-prosthesis and was subsequently recommended for a VIV procedure. Multiple anatomical risk factors for coronary occlusion required a pre-emptive coronary chimney stenting protection. The implantation of an Evolut-R 23 mm valve resulted in a gradient of 21 mmHg thus, a post-dilatation with an 18 mm balloon was performed. Both electrocardiographic and haemodynamic parameters remained excellent, however, a hazardous leaflet dislodgment became evident. Regardless, a prophylactic chimney stenting was performed because of the operator's perceived high risk of late coronary occlusion.

**Discussion** The implantation of transcatheter valves inside failed surgically implanted aortic bio-prosthesis is broadly recognized as a safe and less-invasive alternative to repeated high-risk surgery. Although procedural success is achieved in the great majority of patients, this therapy may be jeopardized by rare but serious complications such as impending or established acute coronary occlusion. Several specific anatomical and procedural risk factors have been identified and primary coronary prevention strategies are often mandatory when they arise. Valve-in-valve post-dilation has been overlooked in its role as an additional risk factor of late coronary obstruction. Therefore, chimney stenting, performed after balloon post-dilation to prevent delayed coronary obstruction, even if the acute coronary event does not occur intra-procedurally, is strongly advisable.

**Keywords** Severe aortic stenosis • Transcatheter aortic valve implantation • Valve-in-valve post-dilatation • Coronary obstruction • Chimney stenting • Case report

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## Learning points

- The increased risk of delayed coronary occlusion induced by balloon post-dilatation, due to an unpredictable further reduction of the distance between final leaflets displacement and coronary ostia, should be seriously taken into account.
- Valve-in-valve post-dilatation may trigger an adverse event that might subsequently occur after any preventive coronary protection has been removed because of both the coronary flow and the haemodynamic status seem to be optimal at the end of the procedure.

# Introduction

Transcatheter aortic valve-in-valve (VIV-TAVR) replacement has become a feasible and satisfactory treatment option for patients with failed aortic bioprosthetic surgical heart valves and considered at high operative risk.

However, some concern still exists regarding the risks of high residual gradient and coronary obstruction (CO), with the latter having the greatest impact on acute morbidity and mortality (1).

Some procedural predisposing risk factors have been identified and the anatomical relationship between the coronary ostia height and the expected final position of the surgical bio-prosthetic leaflets is the most powerful predictive measurement to take into account (2).

However, valve post-dilation has received scarce recognition as an additional procedural trigger for impending CO to this date.

In this case, a perceived angiographic evidence of a highly probable delayed coronary obstruction, caused by the post-dilation of an Evolut-R 23 mm implanted into a degenerated aortic Mitroflow 21 mm bio-prosthetic, led to the subsequent chimney stenting implantation even if the procedure went on uneventfully.

# Timeline

| | |
|---|---|
| Day 1 | A 78-year-old symptomatic patient was admitted with a severely stenotic surgical Mitroflow n.21 bio-prosthesis. |
| Day 2 | • Heart Team deemed re-intervention at high risk and a VIV procedure scheduled<br>• Computed tomography scan: very low coronary heights and some adjunctive risk factors for impending coronary obstruction |
| Day 3 | • Preventive bilateral chimney stenting and self-expandable valve-in-valve implantation.<br>• Post-dilatation and leaflets dislodgment.<br>• Chimney stenting performed despite neither clinical nor haemodynamic signs of coronary flow impairment were evident. |
| Day 6 | Hospital discharge |
| Three months | Outpatient clinic follow-up visit: the patient was alive, asymptomatic, and in good general condition. A NYHA Class I–II was reported. |

# Case presentation

A 78-year-old woman with a past medical history of hypertension, chronic kidney disease, and rheumatoid arthritis, who underwent a surgical aortic valve replacement with a Mitroflow n.21 bio-prosthesis valve 10 years prior, was referred to our hospital due to syncope.

She denied dizziness, chest pain, or palpitations. A Grade IV mid-systolic murmur was audible which was further diagnosed with severe bio-prosthetic valve stenosis.

Transoesophageal echocardiogram confirmed the severity of the stenosis with a peak velocity of 4.7 m/s (<3 m/s), a mean transvalve gradient of 42 mmHg (<20 mmHg) and an estimated valve area of 0.84cm$^2$.

The angiography showed only a challenging take-off of the right coronary artery (RCA). Computed tomography revealed a derived annular area and perimeter measurements which advised implant of a 23-mm Evolut-R valve (CoreValve Evolut-R, Medtronic, Dublin, Ireland) (*Figure 1*).

Age and multiple comorbidities led the Heart Team to consider the patient at high risk for re-intervention therefore, a VIV procedure was scheduled.

A pre-emptive chimney stenting was deemed necessary (*Figure 2*) because of very low coronary heights with the VTCs [(distance of

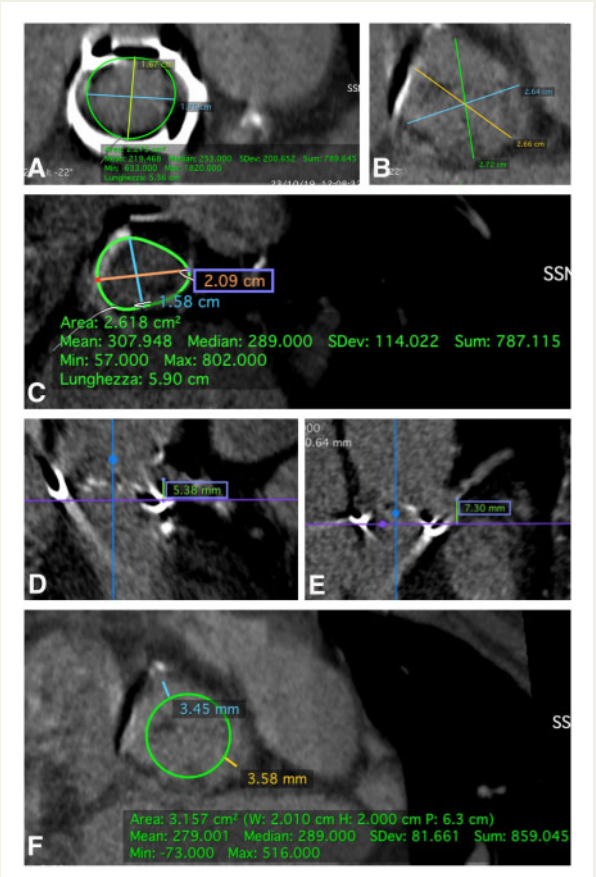


**Figure 1** (*A*) Annulus diameters and perimeter. (*B*) Sinus of Valsalva (SOV) depths. (*C*) Left ventricular outflow tract (LVOT) diameters. (*D*) Left coronary height. (*E*) Right coronary height. (*F*) Virtual valve-to-coronary distance (VTCs).

the coronary ostium to the anticipated final position of the displaced bio-prosthetic leaflets after trans-femoral heart valve (THV)] distances of <4 mm and both the aortic root and the sino-tubular junction resulted small (*Figure 1*).

The haemodynamic gradient resulted in being 47 mmHg, thus the trans-femoral heart valve (THV) was deployed (Supplementary material online, *Video S1*).

After implantation, only a faint pinching of the left main (LM) ostium was observed without signs of coronary flow impairment (Supplementary material online, *Video S2*). The post-implant gradient of 21 mmHg was considered not satisfactory, thus a post-dilatation was performed using an 18 mm sized balloon, lowering it to 9 mmHg (*Figure 3*, Supplementary material online, *Video S3*).

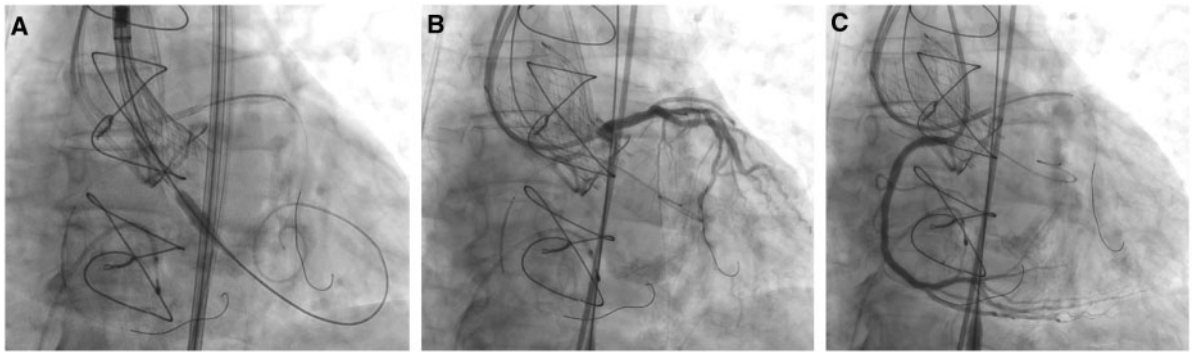


**Figure 2** (*A*) Valve deployment with bilateral chimney stenting. (*B*, *C*) Valve implantation and elective coronary angiography.

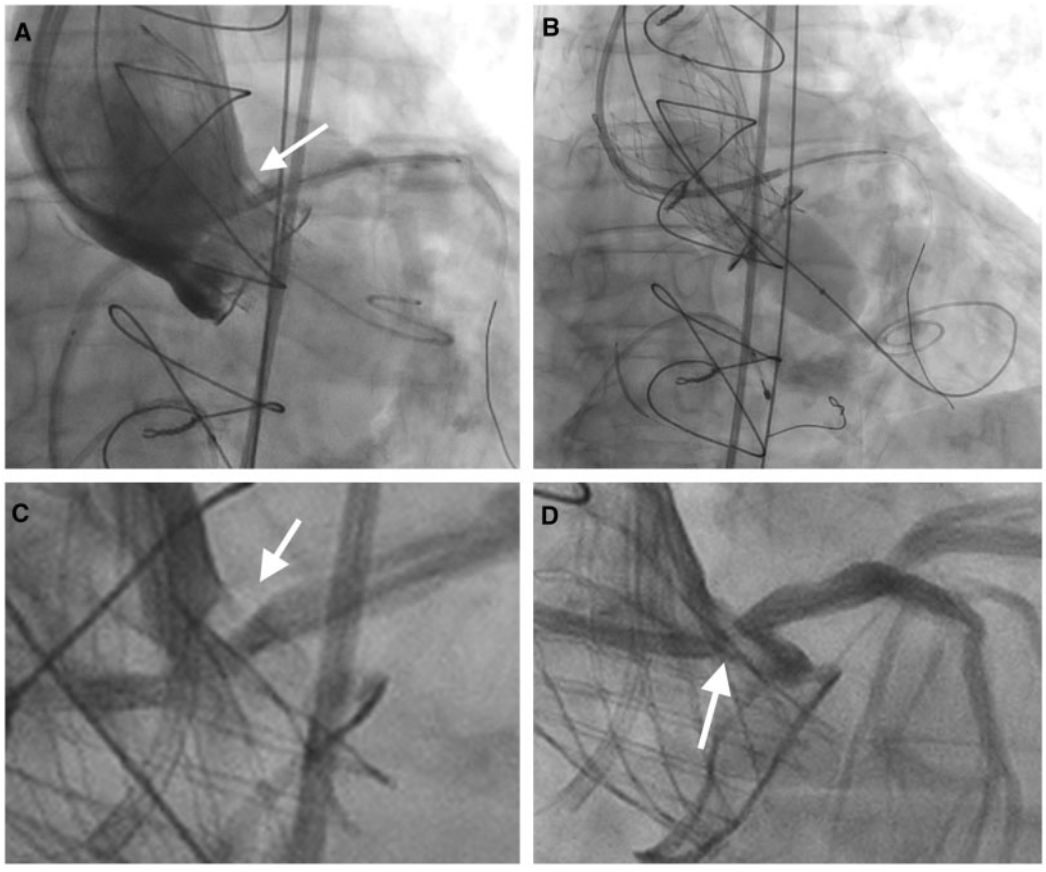


**Figure 3** (*A*) Mild pinching of the left main ostium. (*B*) Post-dilatation. (*C*, *D*) Severe pinching and leaflets dislodgment.

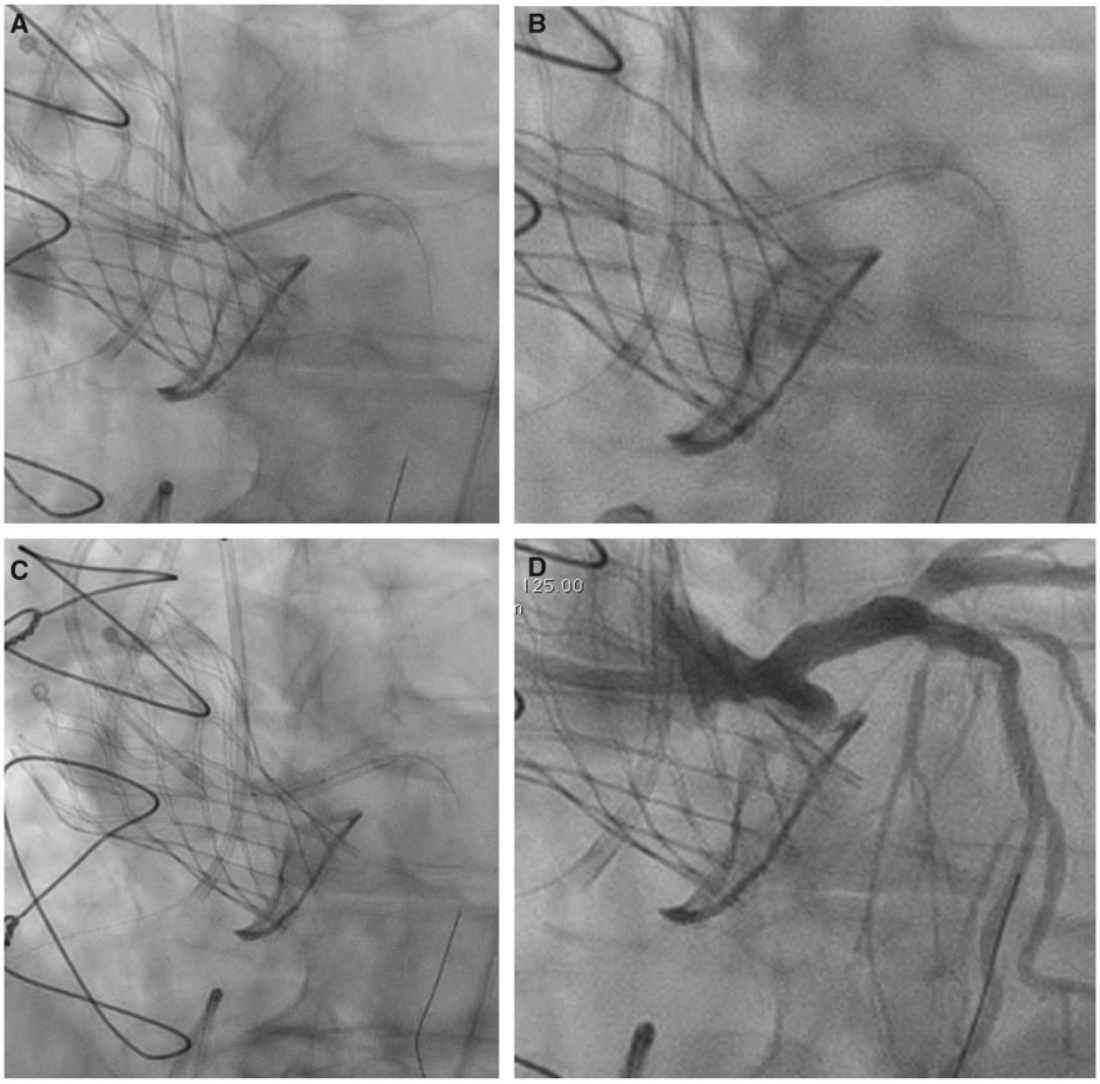


**Figure 4** (*A*, *B*, *C*) Left main stenting and multiple high-pressure optimizations. (*D*) Chimney stenting final result.

However, at the following coronary opacification, the LM pinching worsened and a risky dislodgment of the radiolucent leaflets of the degenerated valve appeared in front of the ostium, albeit no haemodynamic or electrocardiographic signs of coronary underperfusion were evident (*Figure 3*, Supplementary material online, *Video S4*).

Owed to the highly angiographic suspicion of impending CO, the stent was deployed and flared by multiple high-pressure post-dilatations (4.5 mm × 12 mm and 5.0 mm × 8 mm NC balloon up to 20 atm) (*Figure 4*, Supplementary material online, *Video S5*).

The chimney stenting was performed also at the ostium of the RCA because of its posterior take off. Finally, both coronaries were patent with no more angiographic life-threatening images of impending CO (*Figure 5*).

The in-hospital clinical course was uneventful. She reported an NYHA Class I–II and no syncope or chest pain at a 3 months of follow-up.

## Discussion

Nowadays, it is advisable to perform VIV-TAVR for severely symptomatic patients with bio-prosthetic valve stenosis who have a high risk of re-operation.[1]

Despite the high success rate, this procedure is associated with several potential complications, such as significant residual gradient and coronary obstruction (CO) which are the most impactful on acute patients' prognosis.[2, 3]

In fact, CO is about 4- to 6-times more frequent after VIV-TAVR when compared to native TAVR, with an incidence of up to 3.5% and a related in-hospital mortality of about 50%.[1, 2]Stent-less and stented prosthesis are particularly prone to provoking this threatening complication and, remarkably, the lower the VTC, the higher is the risk for CO.[3,4]

A further concern is a high residual gradient which mainly affects VIV-THV in small bio-prosthetic degenerated valves and the implant

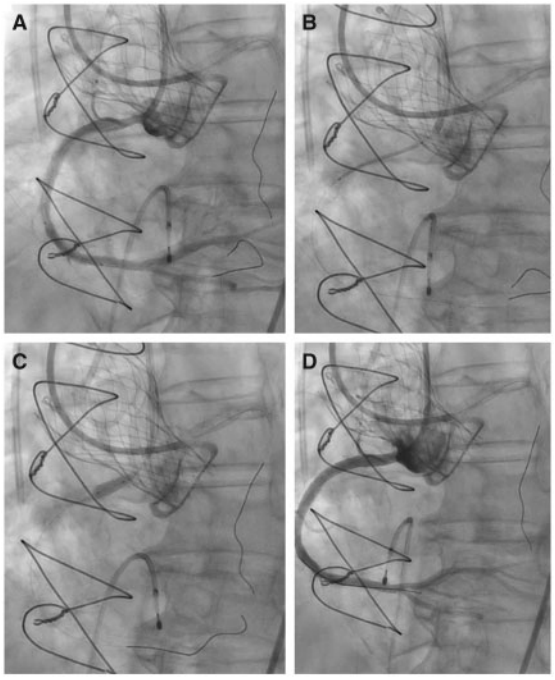


**Figure 5** (*A, B, C*) Right coronary artery chimney stenting and ostial optimization. (*D*) Final result.

of intra-annular and balloon-expandable prostheses.[1–3, 5] In such circumstances, VIV-TAVR post-dilatation is strongly advisable. However, the effects of the VIV-post-dilatation have been overlooked as an additional risk factor of CO. Intuitively, it has the potential for the leaflets and the posts to be further displaced causing a further risky reduction of the aforementioned VTC distance.

In fact, Jabbour *et al.* retrospectively collected 38 cases of delayed CO occurring early (0–7 days) in 24 patients and later (>7 days) in the remaining 14 patients.[4] In the early-CO group, post-dilatation was present in five out of the 24 patients.[4]

Moreover, in the VIVID-registry, among the 1612 VIV procedure patients, a total of 37 cases (2.3%) of symptomatic coronary obstruction occurred following THV implantation. Those who suffered symptomatic CO presented similar baseline clinical and procedural characteristics with respect to controls except a trend towards a higher rate of post-dilatation in the CO group (22.2% vs. 12.7% respectively; $P = 0.07$), although this factor was not retained in the multivariate analysis.[3]

In this regard, the chimney stenting technique is the standard approach for preventing CO during TAVR procedures. If CO occurs immediately after post-dilatation, the pre-emptive delivery of the stent immediately restores the coronary flow and resulted the only predictor of low rate of adverse events.[5]

Conversely, a delayed CO occurred in about 24% of patients even if they underwent coronary guidewire protection during the index procedure.[5] In fact, CO may become clinically evident sometime later since the prosthesis may continue to expand—especially with self-expandable valves—during the early hours after the implantation, thus the aforementioned VTC may worsen later on.[5]

Recently, Palmerini *et al.* demonstrated that chimney stenting during TAVR is generally safe at medium-term follow-up and that stent thrombosis always occurred after VIV in failed Mitroflow valves. Remarkably, in patients not receiving stents, there were four delayed CO occurring from 5 min to 6 h after wire removal and three out of four cases occurred in VIV procedures.[6]

It is worthy to highlight that, although coronary perfusion is maintained after post-dilatation and acute events do not occur intra-procedurally, this cannot be relied upon to decide against a chimney stenting implantation because the impending CO is somewhat subjective to the operator's perception. Therefore, some angiographic features should be checked carefully, especially during VIV cases followed by post-dilatation.

This case emphasized the role that the VIV-post-dilatation may have as an additional hazardous factor of a delayed CO as it may trigger further outward dislodgment of posts and leaflets of the failed bio-prosthetic valve.

## Lead author biography

Dr Alfredo Marchese is the chief of the Interventional Cardiology at Ospedale Santa Maria, in Bari-Italy. He has a prominent role in the executive board of the Italian Society of Interventional Cardiology. He has a particular expertise in the treatment of the left main coronary artery and of bifurcation lesions. His research interests include optimizing antiplatelet therapy during elective CHIP-PCI and minimizing coronary access failure during TAVR procedures.

## Supplementary material

Supplementary material is available at *European Heart Journal - Case Reports* online.

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**Slide sets:** A fully edited slide set detailing this case and suitable for local presentation is available online as Supplementary data.

**Consent:** The author/s confirm that written consent for submission and publication of this case report including image(s) and associated text has been obtained from the patient in line with COPE guidance.

**Conflict of interest:** none declared.

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