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Article type: Clinical vignette

Received: March 21, 2020.

Accepted: May 19, 2020.

Published online: May 26, 2020.

ISSN: 0022-9032

e-ISSN: 1897-4279

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Modified chimney/snorkel stenting of the left main coronary artery after transcatheter aortic valve implantation

Short title: Modified chimney/snorkel stenting after TAVI

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Key words: chimney stenting, TAVI

Word count: 650

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The authors have no conflict of interest
The predominant mechanism of the coronary flow impairment (CFI) following transcatheter-aortic-valve-implantation (TAVI) is mainly due to the displacement of the calcified native cusp over coronary ostia [1] or rarely due to too high position of the implanted bioprosthesis. We present a 67-years-old female patient after mitral valve replacement (MVR) and re-MVR (mechanical prosthesis) several years ago, treated with TAVI for critical aortic stenosis.

Detailed pre-interventional computed tomography angiography (CTA) measurements were done. Distances between aortic annulus- left coronary artery (LCA) ostium and right coronary artery ostium: 12 mm and 18 mm, respectively; maximal radiuses of the Valsalva sinuses: 31x31 mm; left ventricle outflow tract diameter: 19x28 mm. No significant coronary lesions were visualized. Using femoral access Evolut-R 29 mm bioprosthesis (Medtronic, Inc., Minneapolis, MN, USA) was directly implanted and post-dilated. The left main coronary artery (LMCA) remained unprotected during procedure. Aortography performed immediately after TAVI showed both left and right coronaries with non-obstructed ostia. However, too high position of the bioprosthesis with the left leaflet above LMCA ostium could be suspected.

Five months later patient was readmitted due to complaints of exertional dyspnoe. Echocardiography showed diffused hipokinesia of the left ventricle (LV) antero-lateral wall and reduction of LV ejection fraction (EF) from 60% to 30%. Troponin T levels were elevated- 131 ng/L (upper normal limit 14). CTA and non-selective coronary angiography (CA) revealed CFI to LCA due to too high bio-prosthesis position with LMCA ostium below the bioprosthesis leaflets (Figure 1A,B). Thus percutaneous coronary intervention (PCI) was chosen as an optimal treatment strategy. Despite lack of selective LCA intubation with Amplatz-left guide, it was successfully wired. Next, everolimus-eluting stent (3.5x15 mm) was positioned across the bioprosthesis leaflets and further across the bio-prosthesis cell with landing zone in the distal LMCA. Then it was directly deployed and postdilated with 4.0 mm
non-compliant balloon (Figure 1C and 1D). Final contrast injection revealed appropriate LCA filing (Figure 1E). In-stent minimal lumen area was 7.0 mm$^2$ as measured by intravascular ultrasound (IVUS), (Suplementary Figure S1A). The proximal part of the implanted stent was located above the level of the bioprosthesis leaflets as confirmed by postprocedural CTA (Suplementary Figure S1B,C). Echocardiography done four days later and eight months after PCI revealed significantly improved LV function (EF 50% and 60%, respectively).

High implantation of Evolut-R bioprosthesis in our patient was intentionally performed to avoid interference with previously implanted mitral prosthesis and unintentionally caused too high bioprosthesis position (above the LCA ostium). This allowed mainly systolic LCA inflow and only residual diastolic LCA inflow (due to small paravalvular leak), which physiologically is predominant. That most probably caused ischemic deterioration of the LV function. Restoration of the diastolic LCA inflow after LMCA chimney/snorkel stenting allowed significant improvement of LV function.

Procedural aspects regarding TAVI and PCI.

Evidence from previous trials does not support routine use of periprocedural guidance by transesophageal echocardiography (TEE) during TAVI. However, patients after MVR pose more challenge and TEE-guidance during TAVI may be considered, especially in subjects with mechanical valves in the mitral position.

PCI after TAVI may be technically challenging (more difficult selective coronary intubation and poorer catheter support [2]). Subsequently success rate of PCI remains suboptimal [3]. Several cases of intra-procedural chimney/snorkel stenting with prophylactic coronary wire protection during TAVI were reported before [3]. At the end stent protrudes between aortic wall and bioprosthesis-scaffolding. PCI in our patient differed in two ways!. The stent crossed both the bioprosthesis leaflets and the bioprosthesis-scaffolding before entering LMCA (modified chimney/snorkel PCI).
Finally, optimal post-PCI IVUS criteria [4], suggest that LMCA-minimal lumen area should be at least 8.2 mm². Despite postdilatation, this threshold was not achieved in our case. Further, interaction between protruding stent and bioprosthesis leaflets may lead to damage of both structures over time.

In conclusions, too high aortic bioprosthesis impairs blood flow into the LCA. Modified chimney/snorkel stenting may be a reasonable treatment option. Control CA or CTA may be considered at follow-up.
References


Figure 1.

Chimney stenting. A) Contrast injection- left leaflet of the bioprosthesis above the left coronary ostium; B) Magnification of the image “A” with focus on the distance between the left leaflet (black arrow) and the ostium of the left main coronary artery; C) Positioning of the stent across the bioprosthesis cell; D) Stent deployment; E). Final angiographic result.