Percutaneous coronary interventions for bifurcation lesions were historically associated with reduced procedural success and a higher rate of restenosis. The Cappella Sideguard stent (Cappella Medical Devices Limited, Galway, Ireland) was developed to improve side-branch ostial patency. We report a case of Cappella Sideguard stent deformation and stent strut protrusion into the main vessel lumen demonstrated during follow-up intravascular ultrasound (IVUS), 6 months after the index procedure.

Case Presentation
A 47-year-old man with stable angina had significant bifurcation stenosis of the proximal left anterior descending artery (LAD) and first diagonal (D1) (Medina 1,1,1, side-branch take-off >50°), severe stenosis in the distal LAD, and moderate stenosis in the circumflex artery (Figure 1A). The LAD bifurcation was dealt with after first treating the distal lesion. Both branches were predilated, and a Cappella Sideguard stent (2.5 mm×8 mm) was deployed in the D1 branch. A Promus Element stent (2.5 mm×32 mm) was deployed distally, overlapping with the distal edge of the Cappella stent. The LAD was stented with a Promus Element stent (3.5 mm×38 mm), (Figure 1B and 1C). All the stents were postdilated, and a kissing inflation in the LAD and D1 (3.5 mm and 2.5 mm noncompliant balloons, respectively) was performed to high pressure. Postprocedural IVUS evaluation of the stented LAD segment demonstrated good stent apposition, with no evidence of Sideguard stent strut protrusion into the main vessel (Figure 1D). We did not perform IVUS examination to demonstrate that the Sideguard stent was well expanded because the stent was aggressively postdilated.

The patient underwent pressure wire assessment of the circumflex lesion and assessment of the stented LAD bifurcation segment after 6 months. Angiographic appearance of the LAD/D1 was satisfactory. However, IVUS pullback (from D1 into the LAD) revealed asymmetrical under expansion of the Sideguard stent at the ostium of the D1 (Figure 2A). IVUS pullback in the LAD demonstrated a well apposed and expanded main vessel stent, but there was evidence of stent strut protrusion into the LAD lumen at the level just below the bifurcation carina (Figure 2C). We presume that the protruding stent strut is part of the ampullary region of the Sideguard stent, a finding that was not noted at the time of index procedure (Figure 1D). Optical coherence tomography would have provided clearer images of this strut protrusion; however, optical coherence tomography was not available in our unit at this time.

Discussion
The Cappella Sideguard stent is a self-expanding, thin-strut (64 μm), low-stress, nitinol, bare-metal stent with a funnel-shaped flare for ostial coverage. Nitinol derives its unique properties from a solid-state transformation, which can be triggered thermally or mechanically. After stent deployment, the stent continues to exert a constant outward force.

In this case, the 6-month IVUS study demonstrated that the Sideguard stent was underexpanded with severe stent asymmetry. The side-branch stent was constrained by fibrocalcific disease and could not retain its intended shape. This correlates with the phantom model, where the nitinol stent could not overcome the restraining forces that were applied by the test model itself (Figure 2B). Appropriate and aggressive postdilatation was performed at the index procedure; we felt that the subsequent ostial deformation was because of inadequate radial strength of the stent. The actual area on IVUS was satisfactory; there was no significant restenosis, so no further action was taken.

The main vessel IVUS revealed a Sideguard stent strut protruding into the main vessel lumen. It is likely that the Sideguard stent strut has migrated back to its original shape because of the memory effect of nitinol. This finding correlates with the bench test in which the stent strut can be seen protruding into the main vessel lumen (Figure 2D). Therefore, despite jailing the diagonal stent behind the main vessel stent, it appears possible for the Cappella Sideguard struts to protrude into the main vessel lumen.

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From the Belfast Health and Social Care Trust, Belfast, Northern Ireland, United Kingdom (V.N.K., S.J.W., C.G.H.); Bristol Royal Infirmary, Bristol, United Kingdom (T.W.J.); Auckland City Hospital, Grafton, Auckland, New Zealand (J.A.O.).
Correspondence to Colm G. Hanratty, MD, FRCPI, Belfast City Hospital, 51 Lisburn Road, Belfast, Northern Ireland, BT9 7AB, United Kingdom.
E-mail colm.hanratty@belfasttrust.hscni.net
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The implications of a nitinol-based stent strut migrating into a main vessel are unclear. There is a longer-term possibility that a prolapsed stent strut could potentially provide a nidus for thrombosis. In addition, the ostial constraint demonstrated in this case is an area of concern. We felt balloon inflations would only temporarily resolve the issue because the memory of nitinol would return the struts to the same position. There was no clear indication for further stent implantation. Therefore, we elected not to perform any additional intervention and opted for standard dual antiplatelet therapy (12 months).

Conclusion

Longer-term clinical follow-up in a large cohort of patients including adjunctive imaging will be important to confirm the safety and efficacy of this device.

Figure 1. A, Coronary angiogram showing significant stenosis of left anterior descending artery (LAD; white arrows) and diagonal (black arrow) prior to percutaneous coronary intervention. B, Coronary angiogram of the diagonal stent (Sideguard stent, black arrow) and LAD stent (white arrows). C, Final angiogram after stenting of the diagonal (black arrow) and LAD (white arrow). D, Intravascular ultrasound of the LAD lumen just below the level of the bifurcation carina (arrow pointing to angioplasty wire, index procedure).

Figure 2. A, Intravascular ultrasound (IVUS) still image from the diagonal back into the left anterior descending artery (LAD) showing suboptimal Sideguard stent expansion at the diagonal ostium (follow-up). B, Corresponding area on the Sideguard bench test model showing suboptimal expansion at the side-branch ostium. C, IVUS still image of the LAD lumen just below the level of bifurcation carina with Sideguard stent strut visible (white arrow) in the main vessel lumen. D, Corresponding Sideguard bench test model showing the stent strut protruding into the main vessel lumen.

Disclosures

Drs Kodoth, Johnson, Walsh, and Hanratty have no conflict of interest in relation to this manuscript. Dr Ormiston is a member of advisory boards and has received honorarium from Abbott Vascular and Boston Scientific.

References


Key Words: capella sideguard • side branch • stent optimization • nitinol • stent bench testing model
Side-Branch Ostial Constraint and Protrusion of a Nitinol-Based Dedicated Side-Branch Stent Strut Into the Main Vessel Lumen: From Bench Test to Bedside, A Case Report
Vivek N. Kodoth, Thomas W. Johnson, John A. Ormiston, Simon J. Walsh and Colm G. Hanratty

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