Complex Made Easy: Left Anterior Descending Artery Trifurcation Lesion Completely Treated With a Single Device

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ABSTRACT: Coronary trifurcation lesions are a complex subset of lesions. We present a case of a percutaneous intervention of a trifurcation lesion involving the left anterior descending artery and 2 diagonal branches completely treated with one single device, the novel stent-on-a-wire (SOAW) (Svelte Medical Systems), for the whole procedure. The SOAW is an all-in-one device with a bare cobalt-chrome stent mounted on a balloon directly connected to a wire. The stent of the SOAW was deployed in the left anterior descending artery over the ostia of the 2 diagonal branches. Using the same wire plus balloon device of the SOAW, further recrossing in direction of the 2 side branches and balloon dilation of both ostia through the stent struts was possible. Conclusive post-dilatation of the stent was then performed once again with the same SOAW device. The final angiographic result was successful, and patency of the stented segment was confirmed also at 5-month angiographic follow-up.

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Coronary trifurcation lesions are a complex subset of lesions and are substantially more complex than bifurcation lesions when treated with percutaneous coronary intervention (PCI). Bifurcation and trifurcation lesions present challenges in PCI because of higher rates of acute periprocedural complications (dissection, myocardial infarction, acute vessel closure) and less effective long-term outcomes (stent thrombosis, restenosis) as compared to non-bifurcation lesions. The current standard treatment is elective stenting of the main branch and balloon angioplasty only of the side branch(es) (SB) and additional SB stenting (provisional) only in cases of severe dissection or vessel closure.[1] Still, this type of procedure usually requires several wires and balloons (with combined extra costs) to achieve a final angiographic successful result. We report a case of left anterior descending coronary artery (LAD) trifurcation stenosis, treated with one device only, the novel coronary Acrobat stent-on-a-wire (SOAW) system (Svelte Medical Systems). The SOAW is a coronary stent delivery system consisting of a balloon expandable cobalt-chrome thin-strut stent pre-mounted on a delivery catheter platform, which is constituted of a proximal stainless steel shaft, a flexible distal shaft, a nylon low-compliance balloon (on which the stent is crimped), and a spring coil tip wire.[2,3] The device works as a single unit as it can navigate the coronary anatomy using the distal tip as leading wire and the balloon (on which the stent is mounted) can be inflated via a port located proximal to the proximal shaft using a standard indeflator. The device is used primarily for direct stenting. Once the stent is deployed, the balloon-only system can be still used.

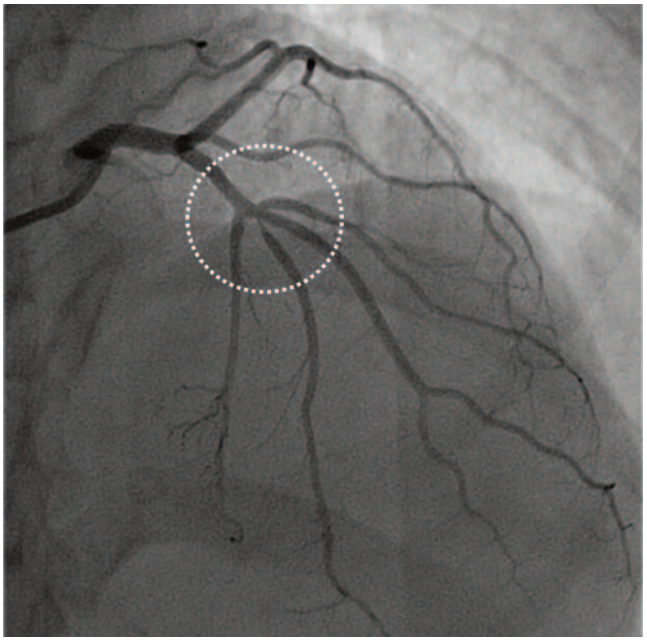

Figure 1. *Coronary angiography showing a severe stenosis in the mid-segment of the left anterior descending artery just after the origin of 2 important diagonal branches (trifurcation lesion, modified Medina classification 0100) (dotted white circle).*

Case report. *A 57-year-old woman with myotonic dystrophy type 1 (without cardiac involvement), acetylsalicylic acid allergy, and without any cardiovascular risk factor, was admitted to our hospital because of progressively increasing chest pain for minimal efforts during the previous few days. The electrocardiogram showed minimal dynamic changes in the anterior leads. A transthoracic*

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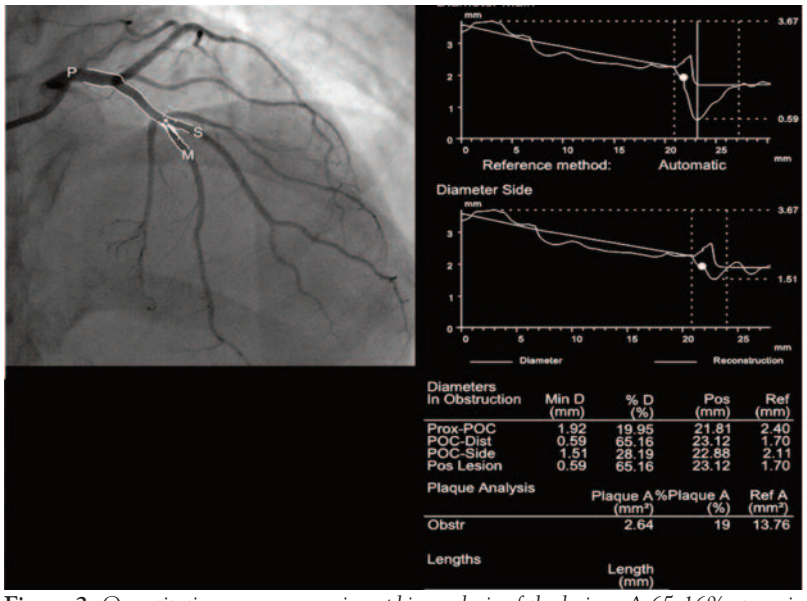

Figure 2. *Quantitative coronary angiographic analysis of the lesion. A 65.16% stenosis of the distal main branch (with a minimal lumen diameter of 0.59 mm, a reference vessel diameter at this level of 1.70 mm, and a lesion length of 6.39 mm) is found. The reference vessel diameter of the proximal main branch is 2.40 mm.*

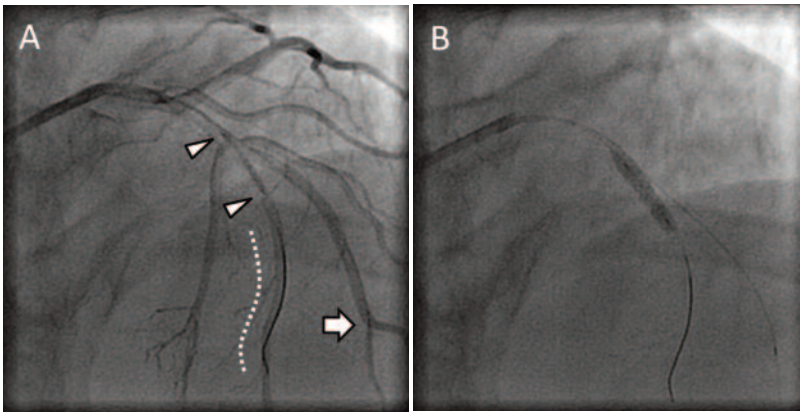

Figure 3. *A 2.5 mm x 13 mm Svelte Acrobat bare-metal stent-on-a-wire is located in the left anterior descending artery at the level of the lesion over the ostia of the 2 diagonal branches (white arrowheads indicate the markers of the balloon on which the stent is mounted; white dotted line marks the distal tip wire of the device itself). The second diagonal branch is "protected" with an additional coronary guidewire (white arrow) (A). The device is inflated at 18 atm (B).*

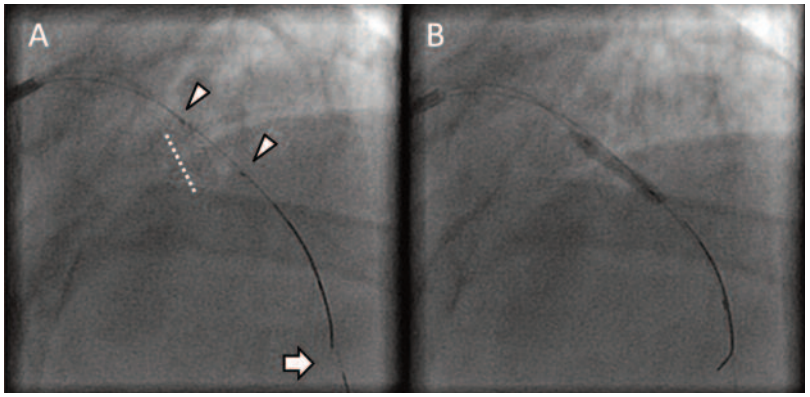

Figure 4. *The balloon is positioned at the level of the ostium of the first diagonal branch (white arrowheads indicate the markers of the balloon) through the stent struts (white dotted line marks the stent). Notice the wire still located in the second diagonal branch (white arrow) and jailed after the stent deployed in the left anterior descending artery (A). The balloon is inflated at 4 atm (B).*

echocardiography revealed minimal left ventricular dysfunction (ejection fraction around 50%) with hypo- or akinesia of the distal septum. Laboratory tests showed minimally increased troponin I and creatine kinase-MB levels.

A diagnosis of acute coronary syndrome was posed, antithrombotic therapy with clopidogrel and low molecular weight heparin was started, and a coronary angiography via the right radial approach was planned. This exam showed a 2-vessel disease with a severe stenosis in the mid-segment of the LAD just after the origin of 2 important large diagonal branches (trifurcation lesion, modified Medina classification 0100, Figure 1), which was considered the culprit of the symptoms, and a moderate stenosis in the mid portion of right coronary artery. Quantitative coronary angiographic analysis results for the LAD lesion are shown in Figure 2. We decided to perform an ad hoc PCI of the LAD trifurcation lesion, avoiding a drug-eluting stent because of the known allergy to acetylsalicylic acid. A 6 Fr ControLateral Support 3.5 guiding catheter was engaged via the right radial into the left main ostium. A 0.014-inch coronary wire was placed in the second diagonal branch and then a 2.5 mm x 13 mm Acrobat SOAW was placed in the LAD at the level of the lesion over the ostia of the 2 diagonal branches and deployed at 18 atm (Figures 3A and 3B). Subsequently, using the same delivery system of the SOAW without a stent, it was possible to recross very easily through the stent struts in direction of the first and second diagonal branches. Both ostia were dilated with the SOAW delivery system respectively up to 4 atm (Figures 4A and 4B) and 8 atm (Figures 5A and 5B). Ultimately, a post-dilatation of the implanted stent was performed once again with the same SOAW delivery system, inflating the balloon inside the stent edges up to 20 atm (Figures 6A and 6B). The final angiogram showed a successful result (Figure 7). The patient was discharged after 2 days without symptoms under clopidogrel, statin, and beta-blocker therapy. After 5 months the patient returned for a planned fractional flow reserve of the moderate lesion of the right coronary artery (which was not significant) and for a control angiography of the stented segment of the LAD trifurcation, which showed a good result with only mild neointimal proliferation in the stent (Figure 8).

Discussion. Coronary artery bifurcation lesions constitute a complex lesion subgroup that is encountered in 15%-20% of all PCI.[4] Treatment of such lesions is associated with reduced

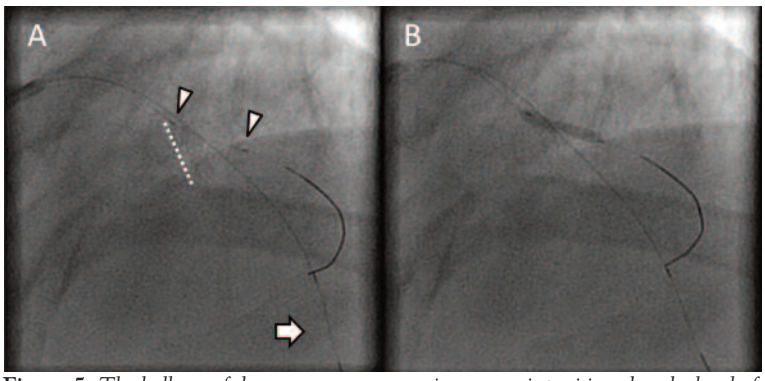

Figure 5. *The balloon of the same stent-on-a-wire system is positioned at the level of the ostium of the second diagonal branch (white arrowheads indicate the markers of the balloon) through the stent struts (white dotted line marks the stent). Notice the presence of the jailed wire in the same vessel (white arrow) (A). The balloon is inflated at 8 atm (B).*

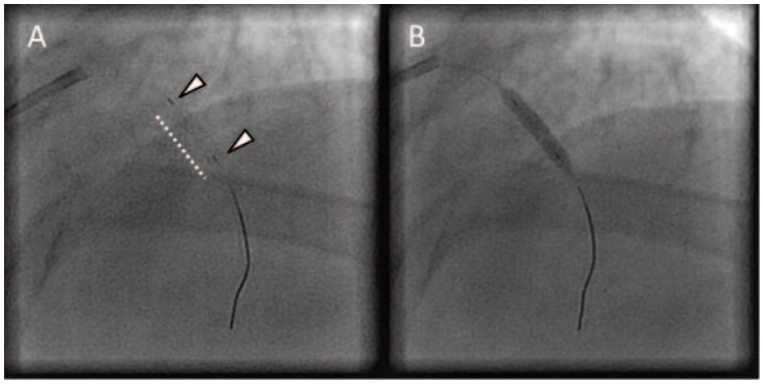

Figure 6. *The same balloon of the stent-on-a-wire system is positioned inside the edges of the stent, deployed in the left anterior descending artery branch (white arrowheads indicate the markers of the balloon; white dotted line marks the stent). Notice in this case the absence of the jailed wire in the second diagonal branch (A). The balloon is inflated at 20 atm (B).*

Figure 7. *Final angiogram showing a successful result.*

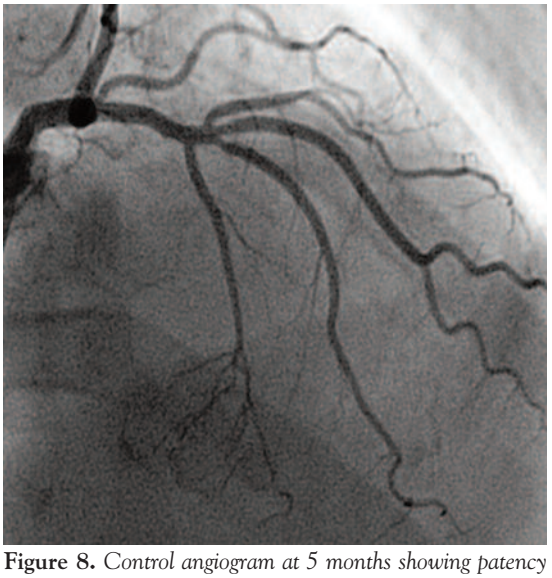

Figure 8. *Control angiogram at 5 months showing patency of the stented segment with only mild neointimal proliferation in the stent.*

procedural success and increased periprocedural and long-term complications. Trifurcation lesions are less frequent and more challenging than bifurcation lesions. The optimal strategy for treating this subset of lesions remains a subject of debate. The consensus is that the systematic multiple stent strategy does not im¬prove either angiographic or clinical outcomes for most patients and that the provisional strategy should be the default approach. In our case report there was a "non-true" trifurcation lesion (modified Medina 0100) without visible severe calcifications and important tortuosity, and with a significant stenosis involving only the distal main branch. Thus a provisional SB stenting technique and a direct stenting technique were chosen as treatment strategies. After stent deployment in the main branch of the bi/trifurcation, dilatation in the direction of the SB through the stent struts is warranted in order to assess the "patency" of the way (for eventual future SB interventions) and to optimize scaffolding of the SB ostium by opening the stent struts in this direction. However, this maneuver can be complicated by difficult recrossing with guidewires and balloons; thus requiring additional time, materials, fluoroscopy, and contrast injections.

Conclusion

In this case, we were able to perform a successful PCI of a complex trifurcation lesion with a novel SOAW stent; a post-stent balloon dilatation of both side branches and the stent itself with the same balloon delivery system. This considerably reduced the use of additional materials, such as guidewires and balloons (with potential economical benefits), radiation exposure, contrast administration, and procedural time.

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