Synergy Megatron Drug-Eluting Stent: An Astute Solution to an Uncommon Complication of Cardiac Surgery

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Videos accompanying this case are available online with the article at cathlabdigest.com.

We report the first case utilizing the Synergy Megatron drug-eluting stent (Boston Scientific) with CTCA/IVUS-guided PCI for an ostial LMCA stenosis post coronary reimplantation at a center without on-site cardiac surgery.

Abstract

Iatrogenic ostial coronary stenosis, a rare complication post coronary reimplantation, poses unique challenges. Specifically, ostial left main stenosis can present with acute pulmonary edema, cardiac arrhythmias, coronary syndromes, or cardiac arrest. Computed tomography coronary angiography is an excellent imaging modality to confirm the diagnosis, as well as plan the subsequent intravascular ultrasound-guided intervention. We report the first case utilizing the Synergy Megatron drug-eluting stent (Boston Scientific) for this rare complication with computed tomography coronary angiography/intravascular ultrasound-guided percutaneous coronary intervention at a center without on-site cardiac surgery.

Iatrogenic ostial coronary stenosis is a rare complication post coronary reimplantation, first described by Robert and Morrow in 1967.[1] Iatrogenic ostial coronary stenosis can affect either the left main coronary artery (LMCA) or the right coronary artery (RCA).[2,3] The literature thus far reports an incidence of 1%-5% in patients who have undergone aortic valve replacement and 5%-6% for the original Bentall procedure.[2,4] Iatrogenic ostial coronary stenosis commonly presents within the first six months; however, late presentation at 22 months has also been described.[3,5] The pathology suggested behind this phenomenon is severe intimal hyperplasia.[6,7] Multiple etiologies have been postulated, one of which is that iatrogenic ostial coronary stenosis could be the result of vessel trauma from the rigid tip cannula during cardioplegia.[6] Alternatively, organization of clot around the coronary ostia could cause mechanical compression or edema at the coronary reimplantation site.[8] It has also been suggested that surgical glue at the anastomotic site could exert external pressure and/or initiate an abnormal inflammatory response.[9,10] Historically, this complication has been treated with coronary artery bypass graft surgery. More recently, patients have been successfully treated through percutaneous coronary intervention (PCI).[3] Computed tomography coronary angiogram (CTCA) is excellent at making the diagnosis of iatrogenic ostial coronary stenosis and provides vital information for preprocedural planning for the subsequent intravascular ultrasound (IVUS)-guided intervention.[3] Here, we report the first case utilizing the Synergy Megatron drug-eluting stent (Boston Scientific) with CTCA/IVUS-guided PCI for an ostial LMCA stenosis post coronary reimplantation at a center without on-site cardiac surgery. The Synergy Megatron platform was chosen for use due to its excellent radial strength and stent overexpansion capability.

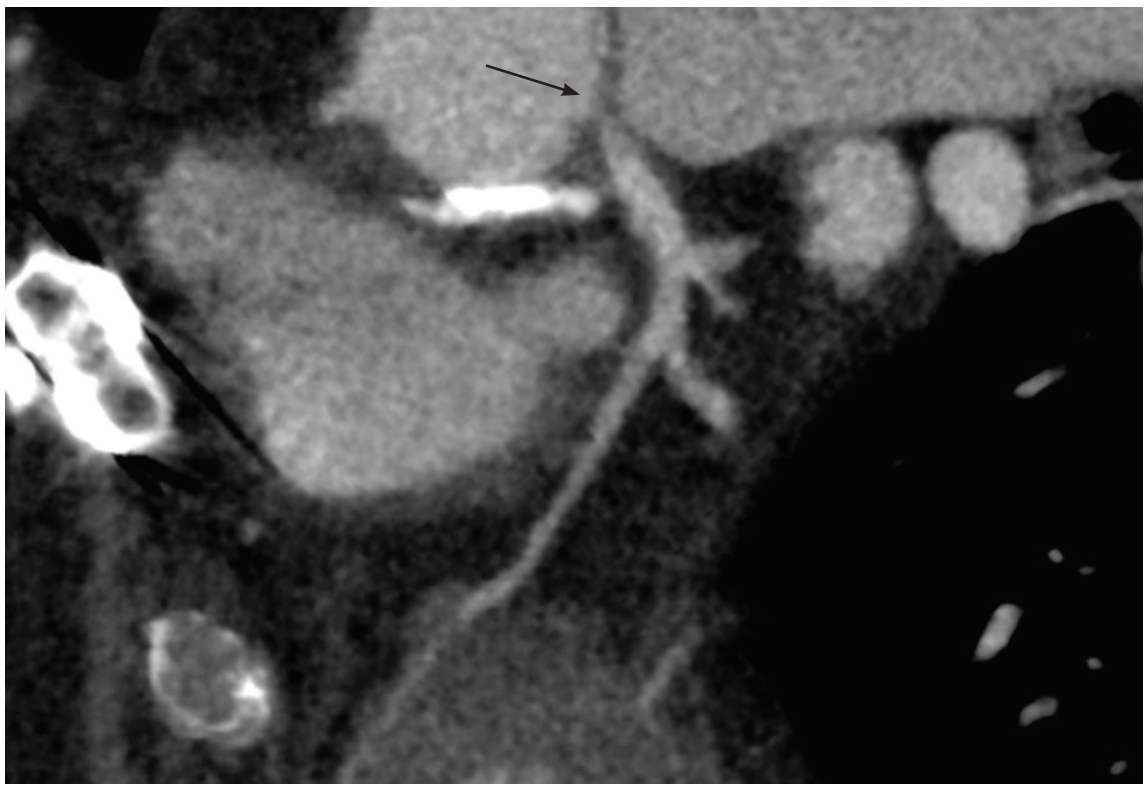

Figure 1. Computed tomography coronary angiography using multiplanar reconstruction reveals a critical ostial left main stenosis.

Case Report

A 62-year-old gentleman presented with a past medical history significant for paroxysmal atrial fibrillation=on warfarin, type 2 diabetes mellitus, and morbid obesity. He has a complicated cardiac surgical history, with a bicuspid severe aortic valve stenosis that was managed with a surgical bioprosthetic aortic valve replacement in 2013. Later in 2021, he developed Granulicatella adiacens bioprosthetic aortic valve endocarditis, complicated by an aortic root abscess and a sizable phlegmon below the origin of the LMCA. An invasive preoperative coronary angiogram revealed normal coronary arteries. The patient underwent a redo sternotomy and an aortic valve replacement with a 25 mm On-X (CryoLife). In addition, he underwent coronary reimplantation and an ascending aorta Dacron graft repair. Six months post procedure, the patient presented with escalating angina pectoris, increased salivation, and diaphoresis. His electrocardiogram demonstrated sinus rhythm with a left bundle branch block and hemoglobin was 14 g/dL, creatinine was 1.0 mg/dL, and blood cultures were

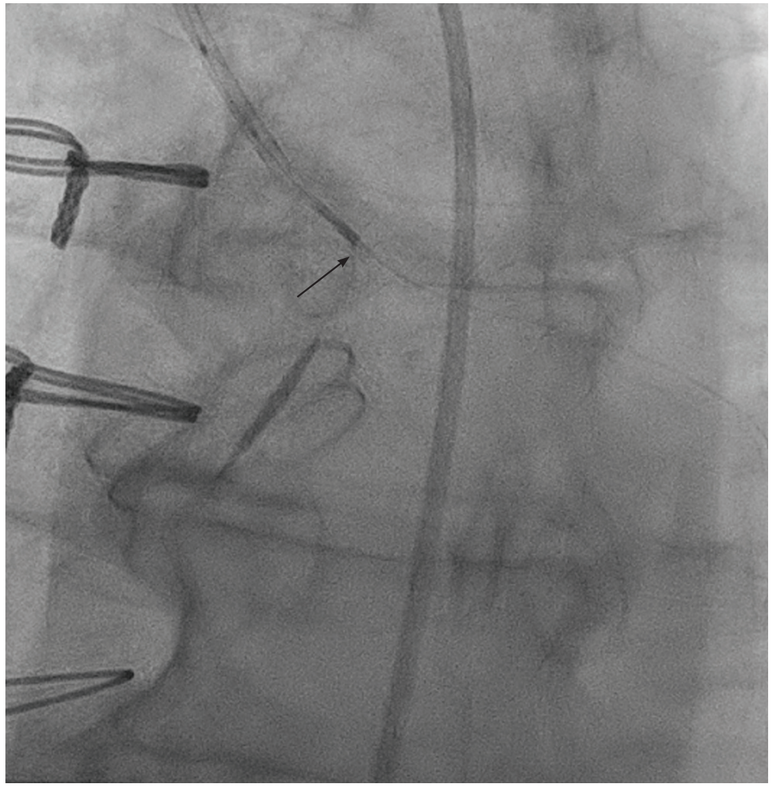

Figure 2. Marking the ostium of the left main on the intravascular ultrasound in the left anterior oblique 18-degree view.

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Video 1. Pre-intervention intravascular ultrasound demonstrating a critical left stenosis.

Video 2. Post-intervention intravascular ultrasound showed a minimal stent area of 14 mm², with excellent stent apposition and ostial coverage.

Video 3. Final angiography in the spider projection revealed TIMI-3 flow with no residual stenosis.

arch and severe tortuosity of the right subclavian artery experienced in the prior procedure. Using an Extra Backup (EBU) 3.5 6 French (Fr) launcher guide catheter (Medtronic), the lesion was wired using a workhorse wire and predilated with a 2.5 mm x 12 mm semi-compliant balloon at 12 atmospheres (atm) in order to accommodate an Eagle Eye Platinum Digital IVUS catheter (Philips). IVUS was used to assess the distal reference diameter, which was congruent with the CTCA (Video 1). The ostium of the LMCA was identified on IVUS and the distal landing zone of 5 mm was identified (Figure 2). The distal LMCA on IVUS measured around 6.2 mm and therefore, a shorter stent was utilized in order to avoid stent malapposition. We successfully stented the ostium of the LMCA with a 3.5 mm x 8 mm Synergy Megatron drug-eluting stent at 14 atm and post dilated with a 5 mm x 12 mm noncompliant balloon at 20 atm.

A high index of suspicion for iatrogenic ostial coronary stenosis is needed while evaluating patients post Bentall procedure/aortic valve replacement.

A final IVUS run demonstrated a minimal stent area of 14 mm², with complete stent apposition and geographical coverage of the lesion, and no distal edge dissection (Video 2). Final angiography showed no evidence of dissection or perforation, with TIMI-3 flow and no residual stenosis (Video 3). The patient was discharged the same day post procedure with triple therapy for one month (aspirin, clopidogrel, and warfarin) and a proton pump inhibitor, to be followed by dual therapy (clopidogrel and warfarin) for 11 months, and later, at one year, warfarin monotherapy only. At 4 weeks, his angina has completely resolved and he remains asymptomatic from a cardiac perspective while attending cardiac rehabilitation.

Discussion

This case illustrates a great amalgamation of astute clinical judgement, multimodality imaging, and appropriate device technology. A high index of suspicion for iatrogenic ostial coronary stenosis is needed while evaluating patients post Bentall procedure/aortic valve replacement. CTCA with 3-dimensional reconstruction is an excellent imaging modality, and was crucial in making the diagnosis of ostial LMCA stenosis and planning the intervention, as highlighted above. The ability to plan in advance meant the operators were able to order the appropriate stent platform for the PCI. During the procedure, IVUS provided consistent measurements. IVUS is crucial for stent optimization and is the standard of care for LMCA PCI.[11] This PCI was performed at a site that is without on-site cardiovascular surgery and where the nearest facility is within 20 minutes by air transport, highlighting the value of preprocedural planning with CTCA, intraprocedural use of IVUS, and astute stent platform selection to increase the safety of the procedure.

The Synergy Megatron (Boston Scientific), an everolimus-eluting platinum chromium platform, is the latest iteration and offers greater axial and radial strength that is idyllic for the treatment of tapered proximal vessels.[12] The platform offers an excellent overexpansion range (3.5-6.0 mm) and has been used in Europe over the last few years. A recent publication described an initial experience among 139 patients, reporting robust outcomes with a cardiovascular mortality rate of 0.7% and zero target vessel revascularization/in-stent restenosis/stent thrombosis.[12] Gelatin-resorcinol glue causing extrinsic compression has been thought to be one of the causes for a bare-metal stent failure for iatrogenic ostial stenosis, as illustrated in a case report by Trivi et al in 2007.[13] For this reason, the Synergy Megatron platform was chosen for its increased radial strength at overexpansion (0.45-0.6 N/mm).[14]

The volume of PCI across non-surgical sites has increased seven-fold over the last few years.[15] Reassuringly, clinical outcomes and complications have not been significantly different across the surgical and non-surgical sites.[16] There always will be a gap in terms what can be safely achieved at a non-surgical site.[17] Compared to non-surgical sites, surgical sites tend to perform more complex, high-risk PCI (unprotected LMCA, chronic total occlusions, calcified lesions needing rotational/orbital atherectomy in patients with severe left ventricular impairment, protected PCI).[17] This gap can be further improved by incorporating excellent preprocedural planning with multimodality imaging and a widespread uptake of IVUS, improving procedural safety and eventually improving outcomes.

Conclusions

To the best of our knowledge, this is the first case utilizing the Synergy Megatron drug-eluting stent to treat a post coronary reimplantation LMCA stenosis at a non-surgical site with CTCA/IVUS guidance. The stent selection was based on the CTCA, and the Synergy Megatron's high radial strength and overexpansion capabilities were crucial for treatment at the location of this stenosis. IVUS is essential for LMCA PCI to confirm optimal stent expansion and geographical coverage. Utilizing all the information derived from the CTCA and IVUS allowed this procedure to be completed safely and efficiently at an outreach facility without surgical backup. ■

References

1. Roberts WC, Morrow AG. Anatomic studies of hearts containing caged-ball prosthetic valves. *Johns Hopkins Med J*. 1967; 121(4): 271-295.
2. Mookhoek A, Korteland NM, Arabkhani B, et al. Bentall procedure: a systematic review and meta-analysis. *Ann Thorac Surg*. 2016; 101(5): 1684-1689.
3. Adamson C, Rocchiccioli P, Brogan R, et al. Post-operative myocardial infarction following aortic root surgery with coronary reimplantation: a case series treated with percutaneous coronary intervention. *Eur Heart J Case Rep*. 2019; 3(4): 1-6.
4. Ziakas AG, Economou FI, Charokopos NA, et al. Coronary ostial stenosis after aortic valve replacement: successful treatment of 2 patients with drug-eluting stents. *Tex Heart Inst J*. 2010; 37(4): 465-468.
5. Shin D, Huang K, Sunjic I, et al. Delayed development of coronary ostial stenosis following surgical aortic valve replacement: a case report of unusual presentation. *Case Rep Cardiol*. 2018; 2018: 8512584.
6. Balbi M, Olivotti L, Scarano F, et al. Percutaneous treatment of left main coronary stenosis as a late complication of bentall operation for acute aortic dissection. *Catheter Cardiovasc Interv*. 2004; 62(3): 343-345.
7. Khan MA, Prati F, El-Omar M. Iatrogenic coronary ostial stenosis of left main stem following aortic valve replacement: visualization with optical coherence tomography. *Cardiovasc Revasc Med*. 2013; 14(5): 299-301.
8. Westaby S, Katsumata T, Vaccari G. Aortic root replacement with coronary button re-implantation: low risk and predictable outcome. *Eur J Cardiothorac Surg*. 2000; 17(3): 259-265.
9. Marino M, Cellini C, Tsiopoulos V, et al. A case of myocardial infarction effectively treated by emergency coronary stenting soon after a Bentall-De Bono aortic surgery. *Cardiovasc Revasc Med*. 2010; 11(4): 263.e5-.263.e9.
10. Martinelli L, Graffigna A, Guarnerio M, et al. Coronary artery narrowing after aortic root reconstruction with resorcin-formalin glue. *Ann Thorac Surg*. 2000; 70(5): 1701-1702.
11. Wang Y, Mintz GS, Gu Z, et al. Meta-analysis and systematic review of intravascular ultrasound versus angiography-guided drug eluting stent implantation in left main coronary disease in 4592 patients. *BMC Cardiovasc Disord*. 2018; 18(1): 115.
12. Mailey JA, Ahmed M, Hogg M, et al. Initial experiences of percutaneous coronary intervention using a new-generation everolimus-eluting stent platform. *J Invasive Cardiol*. 2021; 33(10): E784-E790.
13. Trivi M, Albertal J, Vaccarino G, et a. Ostial stenosis after Bentall technique using glue: percutaneous stenting may be ineffective. *Interact Cardiovasc Thorac Surg*. 2007; 6(4): 511-513.
14. Samant S, Wu W, Zhao S, et al. Computational and experimental mechanical performance of a new everolimus-eluting stent purpose-built for left main interventions. *Sci Rep*. 2021; 11(1): 8728.
15. Goel K, Gupta T, Kolte D, et al. Outcomes and temporal trends of inpatient percutaneous coronary intervention at centers with and without on-site cardiac surgery in the United States. *JAMA Cardiol*. 2017; 2(1): 25-33.
16. Lee JM, Hwang D, Park J, et al. Percutaneous coronary intervention at centers with and without on-site surgical backup: an updated meta-analysis of 23 studies. *Circulation*. 2015; 132(5): 388-401.
17. Afana M, Koenig GC, Seth M, et al. Trends and outcomes of non-primary PCI at sites without cardiac surgery on-site: the early Michigan experience. *PloS one*. 2020; 15(8): e0238048-e.

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Disclosures: The authors report no conflicts of interest regarding the content herein.

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