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CASE REPORT

Side Branch Late Thrombosis After Left Main Coronary Artery Crossover Stenting

Sultan Alotaibi · Hajo Heyer · Gert Richardt · Abdelhakim Allali

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ABSTRACT

Background: With the established use of crossover stenting technique in bifurcation coronary artery lesions, added clinical benefit of final kissing of the side branch remains debatable. We report a case of a stenosis and thrombus formation of an ostial side branch after crossover stenting.

Case Summary: A 38-year-old man was admitted with acute coronary syndrome complicated by acute pulmonary oedema. He was treated with stenting of the left descending artery (LAD) into the left main coronary artery (LMCA) 12 months earlier. Coronary angiography showed a filling defect in the ostial left circumflex coronary artery (LCX). Optical coherence tomography revealed neointimal growth of the LAD stent resulting in narrowing the LCX orifice and a large thrombus behind stent struts. After treatment of the lesion and optimised implantations of drug-eluting stents, the patient was transferred to the intensive care unit and monitored closely. Given his advanced ischaemic cardiomyopathy, the patient is being evaluated for heart transplantation eligibility.

Discussion: Stent struts across a bifurcated major side branch after crossover stenting could risk late stenosis and thrombus formation of the side branch. The clinical usefulness of routine imaging-guided kissing techniques even with good angiographic results in these cases should be evaluated.

Keywords: Coronary angiography; Stents; Myocardial infarction; Percutaneous coronary intervention; Bifurcation; Coronary artery fenestration; Optical coherence tomography; Case report

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S. Alotaibi (✉) · H. Heyer · G. Richardt · A. Allali
Heart Center, Segeberger Kliniken GmbH, Academic Teaching Hospital of the Universities of Kiel, Lübeck, Hamburg, Am Kurpak 1, 23795 Bad Segeberg, Germany
e-mail: Sultan.otb@gmail.com

S. Alotaibi
Cardiac Center, King Fahad Military Hospital, Jeddah, Saudi Arabia

Key Summary Points

Understanding the pathophysiology seen on the coronary angiography is a cornerstone for proper management.

To recognise in intracoronary imaging causes of late stent thrombosis in bifurcation lesions to guide treatment.

To consider final kissing balloon technique in stenting across a major side branch to maintain long-term coronary vessel patency.

DIGITAL FEATURES

This article is published with digital features, including a video, to facilitate understanding of the article. To view digital features for this article go to https://doi.org/10.6084/m9.figshare.20036957.

INTRODUCTION

Treating ostial left anterior descending artery (LAD) with crossover stenting into the left main coronary artery (LMCA) showed better long-term outcomes when compared with ostial stenting alone [1]. However, final kissing of the side branch in such lesions remains debatable [2, 3].

We present a case of an ostial stenosis of the left circumflex artery (LCX) after crossover provisional stenting of the LAD into the LMCA. Utilisation of optical coherence tomography (OCT) facilitated the diagnosis and optimisation of our therapy.

Written informed consent was obtained from the patient for using and publishing his data with all measurements and rights of data protection according to the local ethics committee approved guidelines (Helsinki Declaration of 1964, as revised in 2013).

CASE PRESENTATION

A 38-year-old man with a known ischemic cardiomyopathy was transferred to our hospital for acute pulmonary oedema. He presented with dyspnoea [New York Heart Association (NYHA) functional class III] and angina at rest. On evaluation, the patient was afebrile, and had a blood pressure of 110/76 mmHg, a heart rate of 113 beats/minute and a saturation of 92% in room air. His physical examination was significant for decreased breath sounds limited to both lung bases with bilateral inspiratory crackles.

The patient underwent a primary percutaneous coronary intervention 12 months ago following an acute anterior wall myocardial infarct because of an occluded ostial LAD that was managed by thrombus aspiration and implantation of three everolimus-eluting stents. The crossover stenting into the LMCA was proximally optimised and final kissing was performed. No intravascular imaging modality to aid in planning nor optimising therapy was used. At that time he received dual antiplatelet therapy (aspirin and prasugrel) and tolerated an optimal medical therapy. His mitral valve was surgically reconstructed 9 months later for a secondary ischaemic severe regurgitation.

Notable laboratory results included a serum high-sensitivity troponin T concentration of 5900 ng/L and an N-terminal fragment of pro-B-type natriuretic peptide concentration of 1763 ng/L. Electrocardiogram showed a sinus rhythm with a known left bundle branch block. Transthoracic echocardiography showed a severely reduced systolic ejection fraction of 25% and apical wall hypokinesia. No evidence for intracardiac thrombi or pericardial effusion was seen.

Differential diagnosis included myocardial infarction (both type I and type II) and other acute pulmonary diseases (pneumonia, pulmonary embolism).

Emergent coronary angiography revealed filling defects of the ostial and distal left circumflex artery (LCX) with haziness, suggestive of thrombus formation. After placing a percutaneous transvalvular axial flow pump device

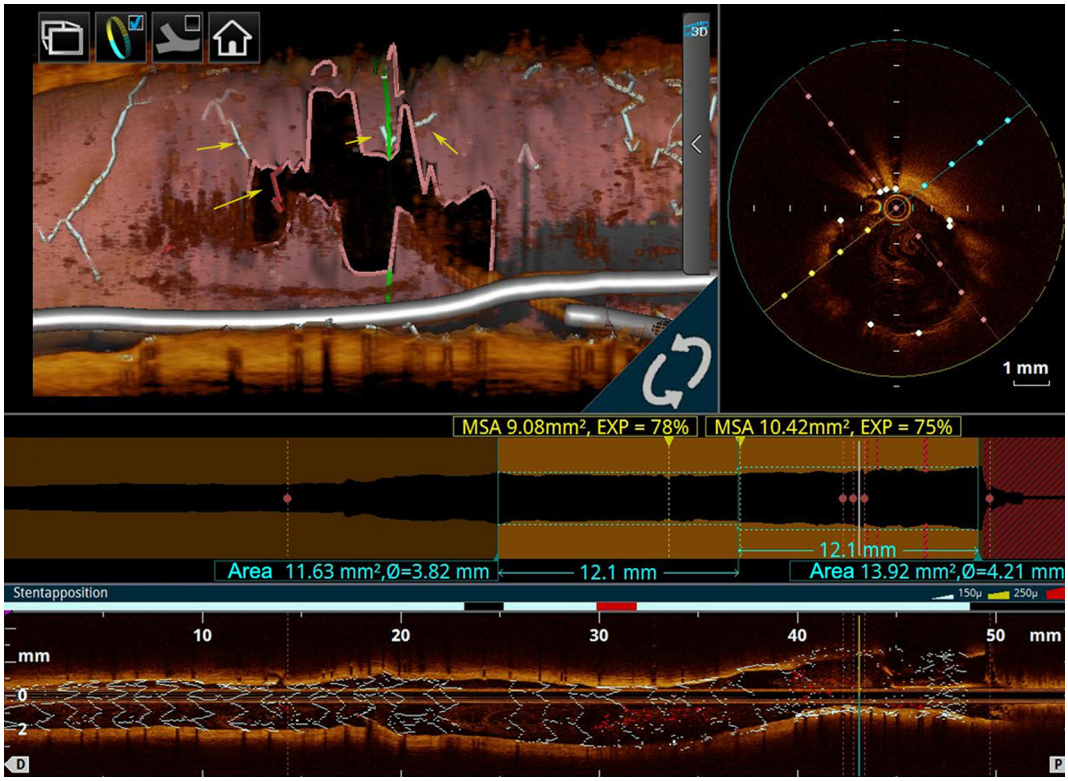

Fig. 1 Optical coherence tomography of the left anterior descending artery. Well-expanded stents and well-apposed stent struts across the left anterior descending artery apart from those covering the left circumflex artery (LCX) ostium. Neointimal growth over stent struts obstructing the ostial LCX and creating an irregular and small orifice (yellow arrows). MSA, minimum stent area; EXP, expansion

for temporary mechanical cardiac support, we engaged the left main artery using a 7-French guiding catheter and wired both the LAD and LCX. We further acquired OCT images to evaluate the lesion and assess the previously implanted stents, which extend from the distal LMCA to the LAD. The obtained three-dimensional OCT pullback from the LAD into the LMCA demonstrated well-expanded stents and well-apposed stent struts apart from those covering the LCX ostium, where we spotted neointimal growth over stent struts that created an irregular fenestrated LCX orifice (Fig. 1). A second pullback of the LCX revealed a large thrombus at its ostium located distal to the LAD stent struts (Fig. 2, Video 1).

There was no evidence of plaque rupture or fissure in the LCX. We performed thrombus aspiration. After opening and opposing the protruding struts in the LCX against the wall with a non-compliant balloon, we deployed an everolimus-eluting stent using a T and Protrusion (TAP) technique. We then preformed a final kissing using two larger non-compliant balloons. By a residual stenosis in the distal LCX we deployed an additional everolimus-eluting stent distally. OCT images demonstrated good expansion of the proximal stent with no signs of distal stent edge dissection and no protruding stent struts in the ostial LCX. A minimal stent malapposition in the LCX was corrected using a non-compliant balloon. The final coronary angiography showed good coronary flow without any dissection (Fig. 3).

The patient was transferred to the intensive care unit and monitored closely. Given the young age of the patient with advanced

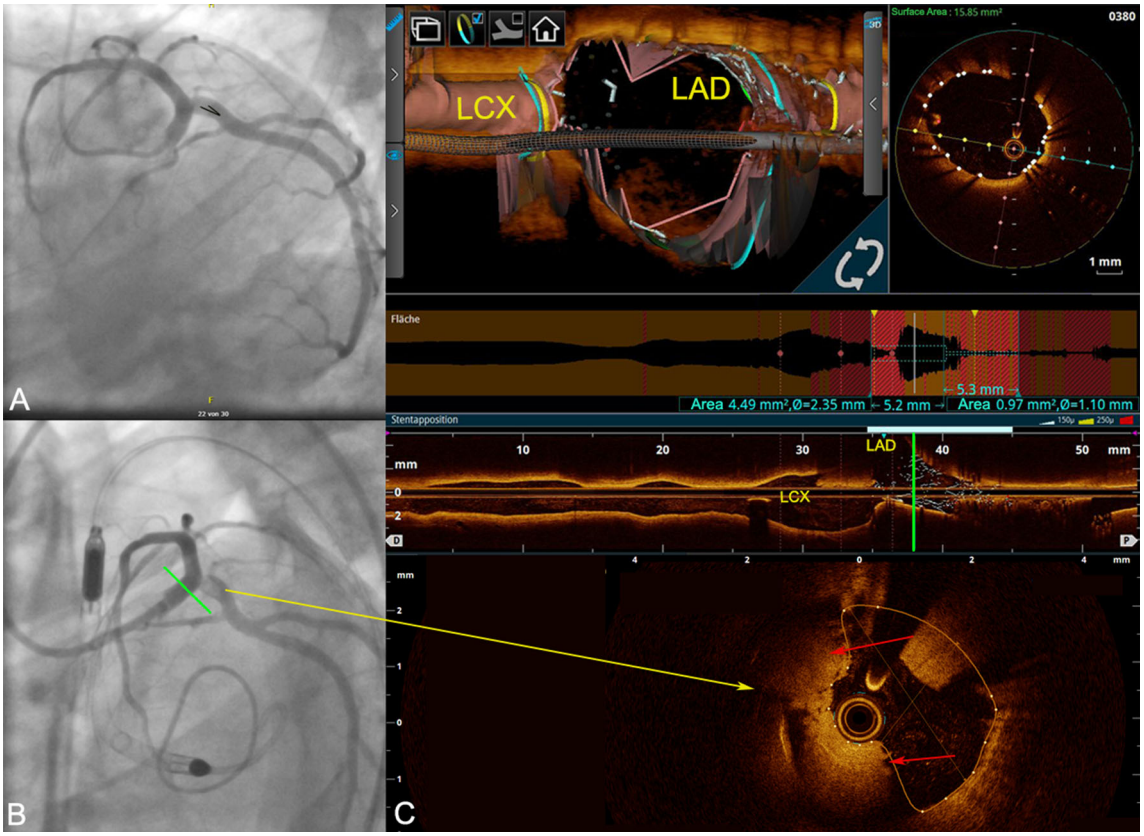

Fig. 2 Baseline invasive assessment and optical coherence tomography of the left circumflex artery. Left coronary angiography in caudal view **a** from the past 12 months compared with **b** actual presentation, revealing hazy images at the ostial left circumflex artery (LCX). **c** Detailed optical coherence tomography of LCX bifurcation showing well-expanded stents in LAD and a large thrombus in LCX behind the bifurcation (red arrows)

ischemic cardiomyopathy, he is being evaluated for heart transplantation eligibility.

DISCUSSION

The clinical significance of a routine final kissing technique following simple crossover stenting remains unclear. A comprehensive volumetric intravascular ultrasound study suggested that applying final kissing might reduce restenosis and target lesion revascularisation by restoring distorted stent symmetry caused by side branch balloon dilatation [4]. However, discordant findings regarding the clinical impact of final kissing after crossover stenting were reported. A randomised trial demonstrated that adding the step of final kissing in LMCA distal bifurcation lesions did not result in better long-term clinical outcome [5]. On the other hand, reports from large registries demonstrated less target vessel revascularisation and restenosis when final kissing is performed [6–8]. A randomised trial showed reduced rates of side branch restenosis with routine final kissing in crossover-treated bifurcation lesions, but no difference in clinical outcome when compared with the no final kissing group of patients. Despite concerns about stenoses resulting from unopened crossover stent struts, the 16th consensus document from the European Bifurcation Club did not endorse a routine final kissing technique for provisional stenting as long as the side branch is not compromised [9]. Given the

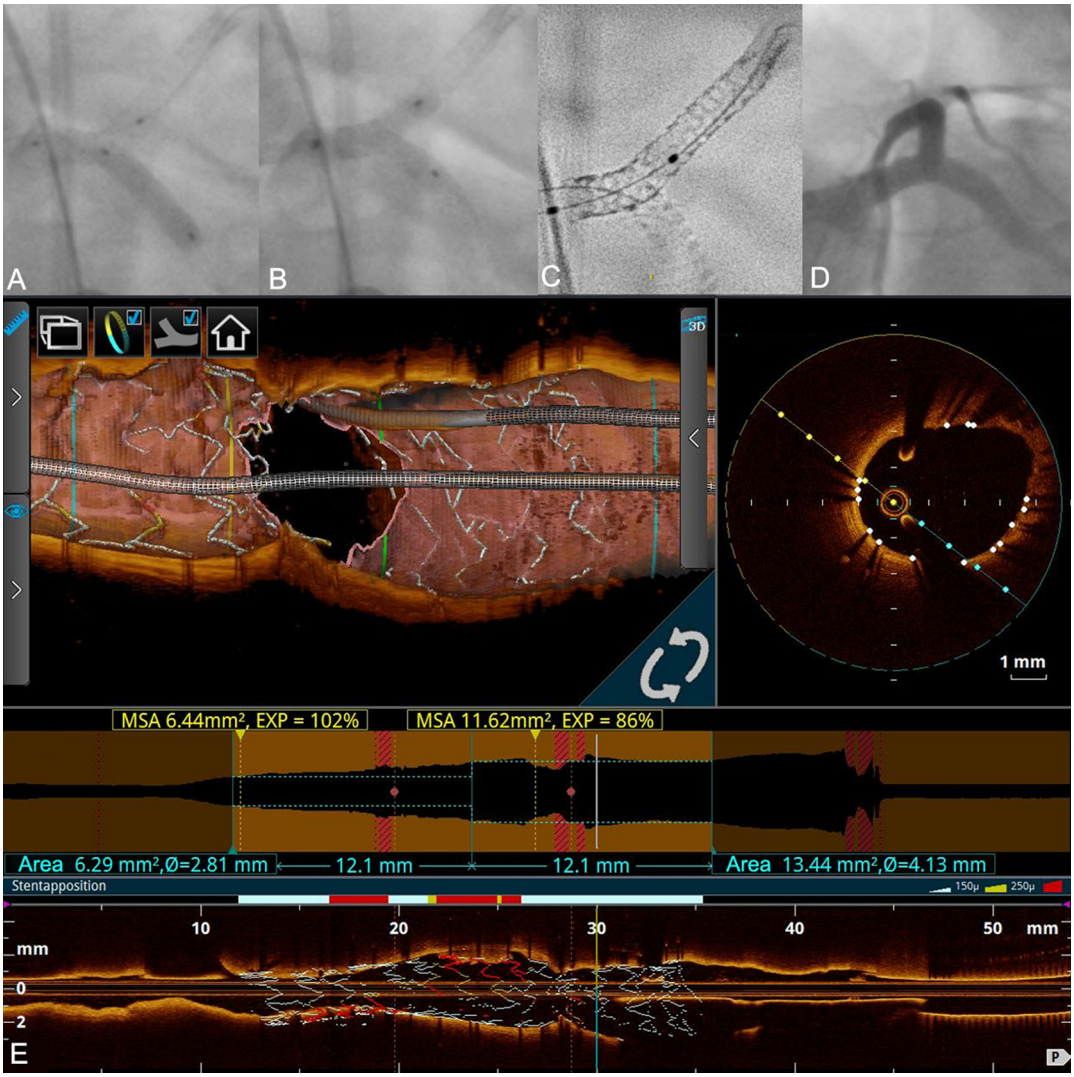

Fig. 3 Treatment of left circumflex artery and final Optical coherence tomography. Coronary angiography showing **a** T and Protrusion **b** final Kissing balloon inflation, **c** stent visualization tool, **d** final coronary angiography. **e** Optical coherence tomography showing good expansion and well-opposed stent and no sign of distal stent edge dissection

angiographic ambiguity during bifurcation intervention, added clinical benefit of routinely using intracoronary imaging such as OCT in guiding therapy is still examined in clinical trials [10].

Our patient presented with a stenosis due to covered stent struts at the ostial LCX despite optimal angiographic results as a side branch after crossover stenting 12 months ago. OCT helped to guide our therapy and showed the thrombus that originated just behind the LMCA. A complete workup ruled out secondary causes suggestive of an embolic origin. In an anatomical reconstruction model of a similar lesion, flow disturbance and different shear rates caused by the struts at the orifice were hypothesised to increase blood thrombogenicity as a possible pathophysiological mechanism [11]. Further research is needed to understand the mechanisms and triggers contributing to such events.

CONCLUSION

Crossover coronary stenting could risk a late stent restenosis and thrombus formation. Advocating a standardised approach, where intracoronary imaging-guided final kissing in crossover stenting is mandated, is only possible after examining its long-term outcomes in large clinical studies.

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Author Contributions. Sultan Alotaibi: data collection, writing and considering the concept and design. Gert Richardt: concept and drafting. Hajo Heyer: reviewing and drafting the data. Abdelhakim Allali: concept and design as well as drafting the case.

Disclosures. Sultan Alotaibi, Hajo Heyer, Gert Richardt and Abdelhakim Allali all having nothing to disclose.

Compliance with Ethics Guidelines. Written informed consent was obtained from the patient for using and publishing his data with all measurements and rights of data protection according to the local ethics committee approved guidelines (Helsinki Declaration of 1964, as revised in 2013)

Data Availability. Data sharing is not applicable to this manuscript (a case report) as no data sets were generated or analysed during the current study and all data are included in this published article/as supplementary information files.

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