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CASE REPORT

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Deferring stent optimization in stent thrombosis: A novel approach for STEMI management—Insights from a case series

Giacomo Maria Cioffi | **Mehdi Madanchi** | **Matthias Bossard** | **Florim Cuculi**

Cardiology Division, Herzzentrum, Luzerner Kantonsspital, Luzern, Switzerland

Correspondence
Florim Cuculi and Giacomo Maria Cioffi, Cardiology Division, Herzzentrum, Luzerner Kantonsspital, Spitalstrasse, 6000 Luzern, Switzerland.
Emails: florim.cuculi@me.com (FC); giacomomaria.cioffi@bluewin.ch (GMC)

Abstract

Treatment of ST represents a challenge. The presence of large amounts of thrombus combined with stent optimization increase the risk of distal embolization. A two-step strategy of stent implantation and deferred stent optimization might be appropriated. We hereby present three clinical cases of ST successfully treated with a two-step approach.

KEYWORDS

distal embolization, optical coherence tomography, PCI, STEMI, microvascular obstruction, stent thrombosis

1 | INTRODUCTION

Nowadays, stent thrombosis (ST) represents a rare but still devastating outcome after percutaneous coronary intervention (PCI) with contemporary stent platforms. The majority of patients present with acute myocardial infarction (AMI), mostly ST-segment elevation myocardial infarction (STEMI), due to thrombotic occlusion of the previously implanted stent.[1,2]

Two issues may make the treatment of ST challenging. First, intravascular imaging (especially optical coherence tomography, OCT) is key to understand the mechanism of ST (differentiation between mechanical and pharmacological factors), but due to the presence of large amounts of thrombus image interpretation is often hampered. Second, in order to correct mechanical factors, particularly under-expansion, the use of appropriately sized balloons (often at high pressure) is necessary, which in turn increases the risk for distal embolization and flow deterioration, thus increasing myocardial infarction size.

In this context, we present three cases of STEMI patients with ST whom we treated with a novel approach aiming to mitigate the risk for distal embolization. Given the large thrombus burden in ST, we therefore followed a two-step strategy of stent implantation and deferred stent optimization using intravascular imaging.

2 | CASE PRESENTATION

2.1 | Case 1

A 48-year-old woman presented with an inferior STEMI. She had undergone PCI and implantation of a drug-eluting stent (DES) to the proximal right coronary artery (RCA) for an AMI 5 years earlier (Figure 1A,B). The angiogram revealed a thrombotic occlusion (TIMI 0 flow) due to very late ST of the previously implanted DES. The angiogram indicated a large thrombus burden. A bolus of intracoronary eptifibatide was administered. After predilatation using a 2.0 mm noncompliant (NC) balloon and thrombectomy (ASAP LP, Merit Medical), we were not able to completely restore flow (TIMI 1) (Figure 1C). The OCT investigation (Dragonfly, Abbott Vascular) indicated the presence of large amount of white and red thrombus and a previously implanted stent,

Cioffi and Madanchi those authors equally contributed to this manuscript and should therefore be considered as shared first authors.

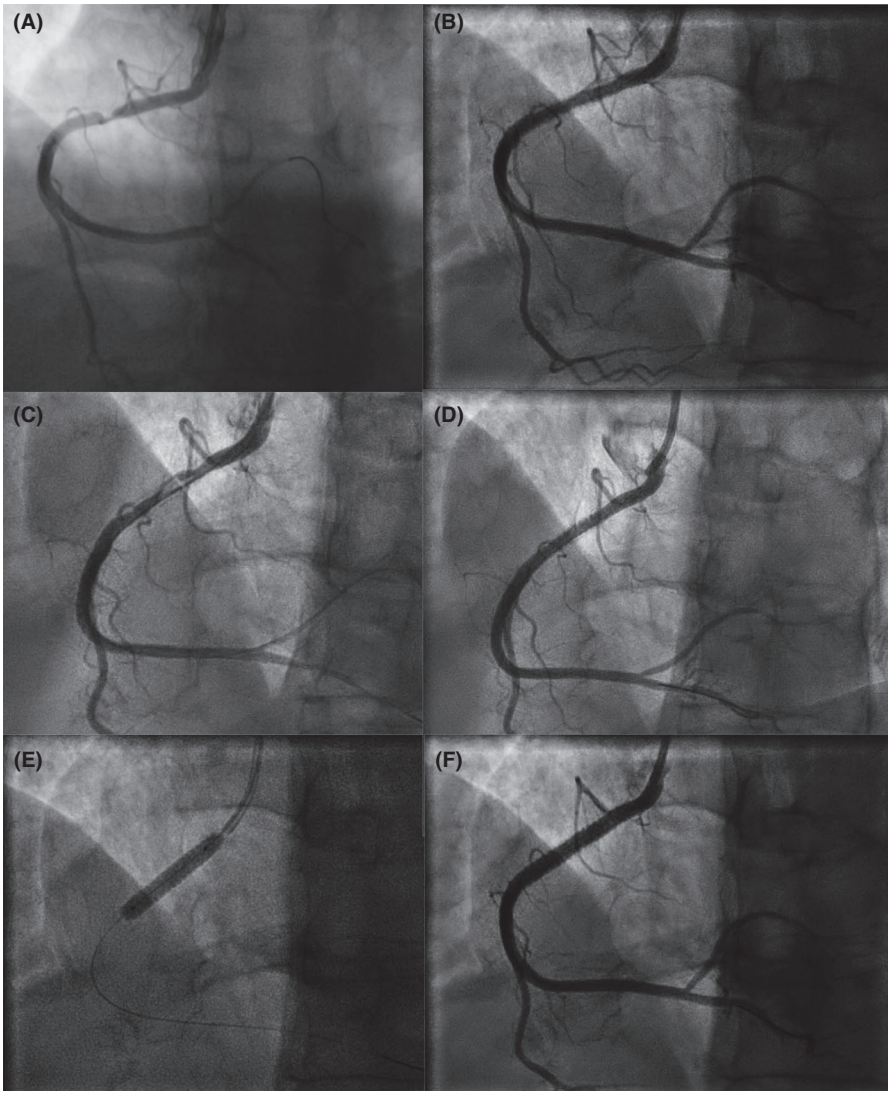

FIGURE 1 Angiography Images. A, B, PCI and DES to the proximal right coronary artery (RCA) for an AMI 5 years earlier. C, Predilatation and thrombectomy not able to completely restore flow (TIMI 1). D, Implantation of a DES at nominal pressure immediately restored TIMI 3 flow. E, F, Postdilatation with a NC balloon corrected stent under-expansion and improved stent apposition

which appeared under-expanded (Figure 2A). Additionally, we observed excessive neointima formation. We successively implanted a 3.5 × 28 mm DES (Xience Sierra, Abbott Vascular) at nominal pressure (12 atm), which immediately established TIMI 3 flow and led to complete ST-segment resolution (Figure 1D). Stent optimization was postponed, and the patient was treated with dual antiplatelet therapy (Aspirin 100 mg qd and Ticagrelor 90 mg bid) and therapeutic dosage of dalteparin. Five days later, OCT-guided stent optimization was performed. Small amounts of residual thrombus were still present, and we observed under-expansion of the initial stent as well as under-expansion and malapposition of the newly implanted stent (Figure 2B). A 4.0 mm (NC) balloon (Easy T NC, SIS Medical Switzerland) was used (inflation pressure 25 atm), which corrected stent under-expansion and improved stent apposition, as confirmed by angiography and OCT (Figure 1E,F; Figure 2C). Coronary flow was not impacted (final TIMI flow 3). Our patient was discharged after 6 days. She recovered well and her follow-up echocardiogram revealed an only mildly reduced left ventricular ejection fraction (LVEF 50%).

2.2 | Case 2

A 57-year-old man, with a history of an anterior STEMI requiring stenting of the proximal left anterior descending (LAD) 2 years earlier, was admitted with a repeated anterior STEMI due to very late ST. Predilatation with 2.0 mm balloon at very low pressure (6 atm) and bailout thrombectomy (ASAP LP catheter, Merit Medical) due to large thrombus amount were performed. Additionally, intracoronary eptifibatide and adenosine were administered, but TIMI 3 flow was only established after placement of a 3.0 × 18 mm DES (Xience Sierra, Abbott Vascular) at nominal pressure in the proximal LAD. No postdilatation (PD) was performed. Four days later, OCT-guided PCI was performed and confirmed an under-expanded stent, but no residual thrombus. A 3.5 mm ultra-high NC balloon

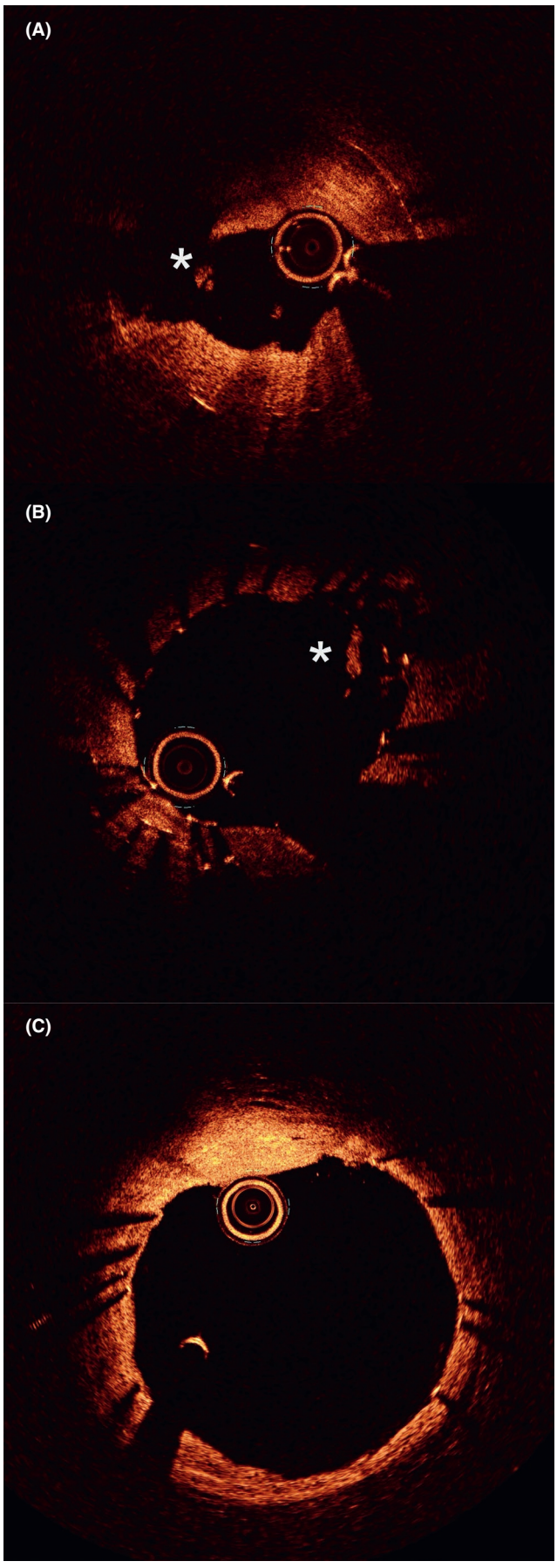

FIGURE 2 OCT Images. A, Presence of large amount of white and red thrombus, excessive neointima formation and a previously implanted and under-expanded stent. B, 5 days later, OCT-guided stent optimization showed residual thrombus, under-expansion, and malapposition of the newly implanted stent. C, Aggressive postdilatation with NC balloon corrected stent under-expansion and improved stent apposition

(OPN NC, SIS Medical) at 35 atm was used to enhance stent expansion, and an additional DES was implanted distally to correct a geographic miss. Ultimately, a 3.5 mm semicompliant (SC) balloon was used to achieve optimal stent apposition, which was confirmed on OCT. The patient was discharged on day 5. His left ventricular function had almost normalized at follow-up 17 months later (LVEF 52%).

2.3 | Case 3

A 62-year-old man, with a history of a NSTEMI 7 years earlier requiring treatment of the proximal LAD using a DES, underwent primary angioplasty for anterior STEMI due to very late LAD ST. After predilatation with a 2.0 mm SC balloon and administration of intracoronary eptifibatide, a 3.5 mm DES (Xience Sierra, Abbott Vascular) was implanted at nominal pressure, which immediately re-established TIMI 3 flow. Four days later OCT-guided stent optimization was performed using a 3.5 mm OPN NC balloon at 40 atm to correct under-expansion and 4.0 mm SC balloon at 16 atm to optimize apposition. His follow-up remained uneventful, and he recovered well. Of note, his latest LVEF was 55% with mild anterior hypokinesia.

3 | DISCUSSION

We need to take into account that advances in AMI management, including potent antithrombotic drugs, rapid interventional reperfusion strategies, and advancements in coronary stent designs have rendered ST a rare complication after DES implantation. The incidence of ST at 30 days after PCI is <1%, whereas late and very late ST rates are 0.5%-1% and 0.2%-2% per year, respectively.[3]

Established factors concurring to ST include first, stent under-expansion and malapposition, which are especially common in calcified and tortuous vessels; second, stent placement in small vessels (vessel diameter <2.5 mm) and/or a long lesion may also be related to impaired and turbulent coronary flow; third, edge dissections compromising coronary flow; and finally, hypercoagulability or inappropriate platelet inhibition (eg, nonresponse to clopidogrel).[4] According to the timing of the event, the ST is labeled as

early (within 1 month of initial placement), late (between 1 and 12 months), and very late (after 12 months).

In this report, we are focusing on ST due to stent under-expansion and describe how we addressed this issue in the three patients presented above.

Current guidelines recommend intravascular imaging to elucidate the mechanism of ST. Due to the higher spatial resolution, OCT might provide more detailed information about stent apposition, stent expansion, and the presence of relevant edge dissections. But performing OCT imaging during acute STEMI is challenging due to the presence of large amounts of thrombus making visualization of relevant portions of the stent impossible. Additionally, vessel size is likely to be underestimated in the acute setting due to high levels of circulating vasoconstrictive hormones, namely catecholamines and vasopressin.

In acute ST with AMI, it is crucial to achieve TIMI 3 flow as soon as possible without going through a phase of flow deterioration, which is usually the consequence of distal embolization of clot, microvascular spasm, thrombosis, and friable atheromatous plaques.[5] The "burden" of thrombus in patients with STEMI undergoing primary PCI has been identified as a major determinant of outcomes, having been associated with reduced procedural success and worse early and late event-free survival.[6] In selected cases of ST, plain old balloon angioplasty (POBA), an thrombus aspiration, might represent an alternative strategy. However, one needs to take in account that thrombus aspiration has been shown not to be superior to PCI as a primary strategy in MI patients (TOTAL Trial[7]).

Moreover, it is crucial to correct mechanical factors (particularly stent under-expansion) in order to correct the cause of ST and prevent repeat target lesion failure. In order to minimize this risk, we administer potent dual antiplatelet agents (including GPIIb/IIIa inhibitors if necessary) and anticoagulation for a certain period (usually 3-5 days) and we keep the time to the staged PCI for stent optimization short (normally within 3-5 days).

Furthermore, aggressive mechanical expansion is an additional known risk factor for distal embolization and microvascular injuries, especially for patients with AMI.[8]

4 | CONCLUSIONS

Our case series suggests that applying a two-step approach (Central Illustration) in patients with STEMI due to ST is safe and effective. After mechanical recanalization with small balloons and/or manual thrombectomy, we advocate the implantation of an appropriately sized stent at nominal pressure strictly avoiding postdilatation. In the three cases presented, stent implantation immediately restored TIMI 3 flow and the procedure could be finished quickly. We did not observe any flow deterioration (slow-flow or no-reflow) secondary to distal embolization. When bringing the patients back for stent optimization, usually 3-5 days later, we used OCT to elaborate the mechanism of ST, assess vessel size, and check for geographic miss. Use of aggressive balloon dilatation was well tolerated at this point in time and did not cause slow-flow or even no-reflow. Whether this strategy would be a valid approach in larger cohort of patients with STEMI remains to be seen. However, we believe that provisional stent implantation to push thrombus aside and re-establish flow (and optimize 3-5 days later) in ST might reflect a promising and safe approach for patients with STEMI presentation and large thrombus burden.

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CONFLICT OF INTEREST

GM Cioffi and M Madanchi report no conflicts of interest. M. Bossard has received consulting and speaker fees from Amgen, Astra Zeneca, Bayer, and Mundipharma. F Cuculi has received consulting and speaker fees from SIS Medical and Abbott Vascular.

AUTHOR CONTRIBUTIONS

GMC: contributed to conceptualization, drafting of the manuscript, graphical work, and images. MM: contributed to conceptualization and drafting of the manuscript. MB and FC: contributed to conceptualization and critical/final review.

ETHICAL APPROVAL

We hereby state that all patients gave formal written consent for scientific purposes and research.

ORCID

Giacomo Maria Cioffi https://orcid.org/0000-0002-8539-1949
Matthias Bossard https://orcid.org/0000-0002-1587-2819

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