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Case Report

Nearly catastrophe coronary perforation: Is it second drug-eluting stent effective?

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Abstract

Coronary artery perforation (CAP) is an uncommon yet serious complication. Although severe perforations (Ellis III) have become more frequent, the overall mortality rate associated with perforations (7.5%) has decreased in recent years. Unfortunately, our medical facility cannot always access a cover stent. The aim of this case report was to demonstrate the effectiveness of using a second drug-eluting stent as an alternative and successful treatment approach in a CAP patient. This is the case of a 67-year-old female with stable angina pectoris Canadian Cardiovascular Society classification III (CCS III), three-vessel coronary artery disease (CAD), who declined CABG (Syntax score of 44) and had type II diabetes mellitus. The patient underwent elective percutaneous coronary intervention (PCI), and we identified diffuse stenosis in the proximal to distal portions of the left anterior descending artery (LAD) with extensive calcification. Furthermore, there was a chronic total occlusion (CTO) in obtuse marginal (OM) 2, as well as critical stenosis in OM3, 80% stenosis in the proximal part of right coronary artery (RCA), 90% stenosis in the middle of the RCA, 90–95% in the distal RCA, and diffuse stenosis ranging from 70–80% in the distal posterolateral. During the procedure to alleviate the stenosis in the left circumflex artery (LCx), we encountered a coronary perforation classified as Ellis type III while using a 2.5/20 mm NC balloon inflated to 12 atm for 12 seconds. In response, we performed stent placement from the proximal LCx to OM2 using the Xience Xpedition drug-eluting stent (DES) measuring 2.5/28 mm. Subsequently, we conducted extended balloon inflation (intermittent) for five minutes. Despite these efforts, the coronary perforation, still classified as Ellis type III, persisted. We decided to employ intrastent stenting (a second DES strategy) with the Coroflex Isar DES measuring 2.5/28 mm, followed by prolonged balloon inflation. The outcome revealed no remaining perforation, Thrombolysis in Myocardial Infarction (TIMI) III flow, and no complications such as pericardial effusion after 48 hours of monitoring. The implantation of a second DES proved to be a practical approach for managing a significant CAP.

Keywords: Coronary artery disease, coronary perforation, PCI, second drug-eluting stent, LCx

Introduction

Coronary artery perforation (CAP) is a significant complication arising from percutaneous coronary intervention (PCI), demanding awareness, early detection, and prompt management by physicians. The occurrence of CAP is infrequent, with reported rates ranging from 0.29% to 0.93% in published PCI series [1-3]. Severe perforations (Ellis III) have become more common,

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but the overall mortality rate associated with perforations has decreased to 7.5% [4]. Even when CAP is recognized and treated promptly, the outcomes are often unfavorable, leading to high rates of mortality, myocardial infarction (MI), and the need for target vessel revascularization (TVR) [5].

Previous reports have associated CAP with specific patient characteristics, including older age and female gender, and features of the target vessel, such as severe tortuosity, calcification, and chronic total occlusion. Additionally, certain procedural aspects, such as atheroablative techniques, cutting balloons, or intravascular ultrasound, have been linked to CAP [6]. The potential life-threatening consequence of CAP arises from hemodynamic compromise and subsequent cardiac tamponade [7,8]. The Ellis classification is commonly employed to assess the severity of CAP angiographically and to predict the risk of adverse events like emergent cardiac surgery, myocardial infarction, tamponade, or death [9].

Cardiologists should be capable of recognizing CAP and understanding the available treatment options. However, thus far, treatment options have primarily been described in case reports, and comprehensive review articles may not encompass the full range of treatment approaches [10,11]. With the advancement of newer technologies, addressing coronary perforation has become more straightforward compared to earlier methods used for managing this complication [7,12]. Notably, the availability of more deliverable-covered stents and microcatheters has improved the management of CAP [13]. The aim of this case report was to illustrate the effectiveness of using a second drug-eluting stent (DES) to address coronary perforation.

Case

A 67-year-old female patient was consulted for coronary angiography because of chest pain on exertion since three years ago. There was no complaining about shortness of breath, fatigue, and ankle swelling. She had a history of coronary artery disease 3 vessel disease (CAD 3VD) with syntax score 44 who rejected coronary artery bypass graft (CABG) in 2022, type 2 diabetes mellitus since 10 years ago. On examination, her pulse rate was 68 beats per minute and blood pressure was 128/90 mmHg. We found no abnormality on the physical examination. Electrocardiography showed sinus rhythm with HR 68 bpm, normoaxis, incomplete right bundle branch block (RBBB), and ST depression in V5, V6, I, aVL. In laboratory finding, we found no abnormality. The patient assessed with Stable Angina Pectoris Canadian Cardiovascular Society (CCS) III, CAD 3 VD, type II diabetes mellitus. The patient treated with clopidogrel 75 mg once daily, atorvastatin 40 mg once daily, nitroglycerin 2.5 mg twice a day, and bisoprolol 2.5 mg once daily, subcutaneous insulin aspart 8–8–8 IU, and subcutaneous insulin glargine 0–0–0–12 IU.

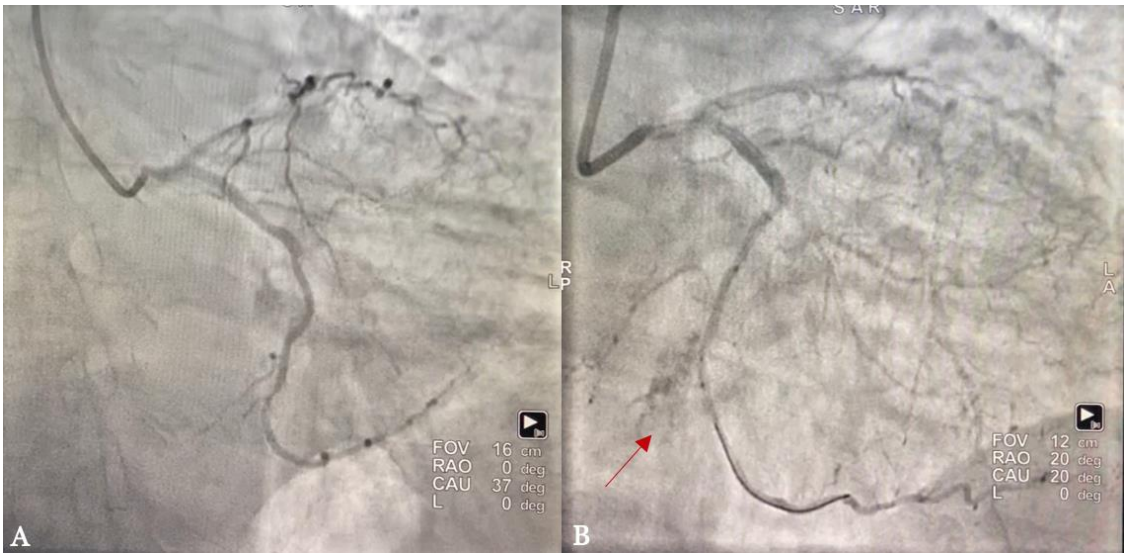

Figure 1. Coronary total occlusion (CTO) in obtuse marginal (OM) 2 also critical stenosis in OM3 (A). Arrow showed coronary perforation Ellis's classification type III (B).

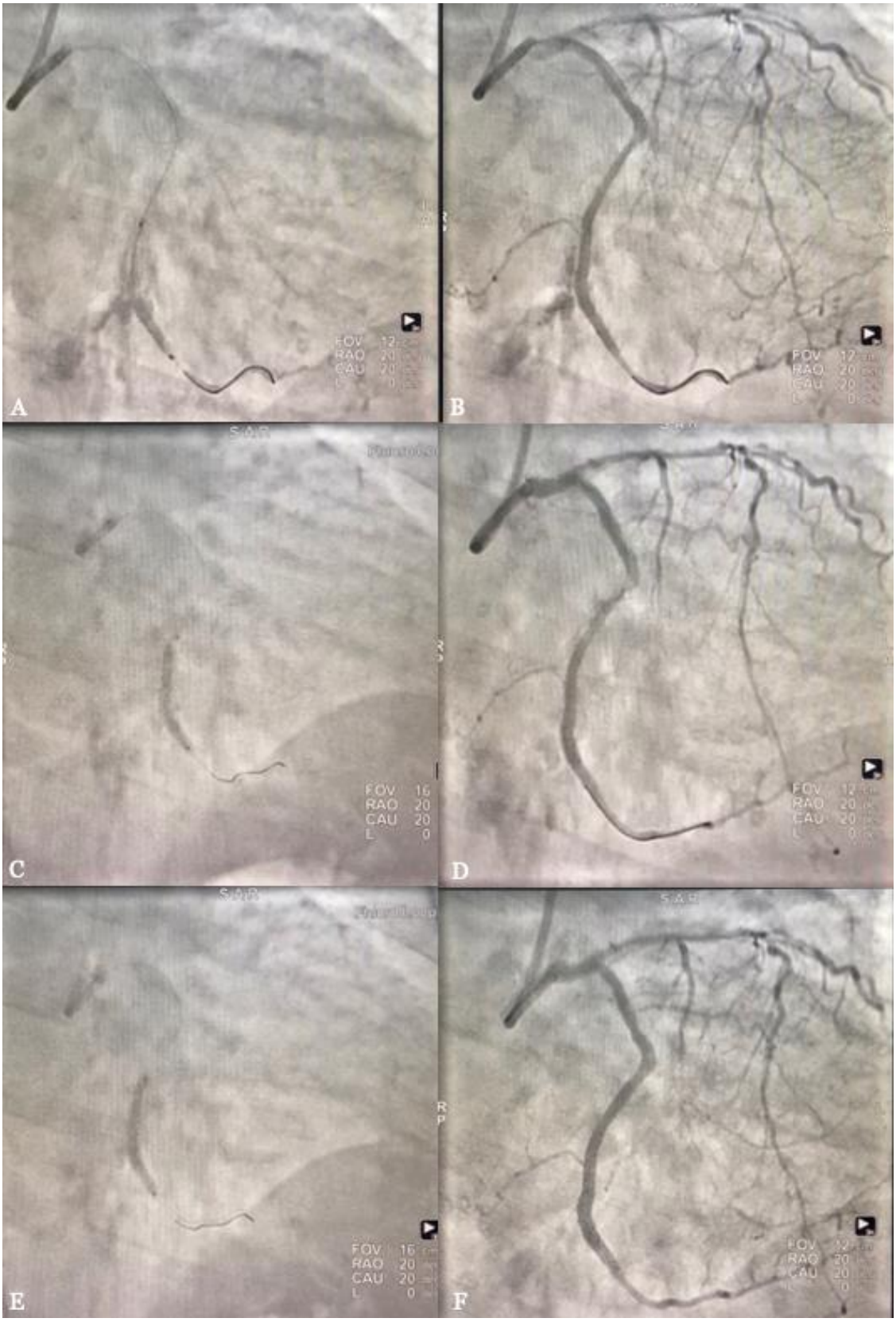

Figure 2. Coronary perforation is still ongoing after stenting with a drug-eluting stent (DES) 2.5/28 mm (A and B). Prolonged balloon inflation (C), coronary perforation still ongoing (D). Intrastent stenting with drug-eluting stent (DES) 2.5/28 mm (E), perforation disappeared (F).

The patient underwent coronary angiography with right radial access. After puncture and cannulation of a 5F introducer sheath 5000 IU of heparin and 500 mcg was administered. The

ultimate-5F guiding was successful approach and visualization right-left coronary artery. We found that left main (LM) was normal, diffuse stenosis in proximal-distal of left anterior descending artery (LAD) with heavy calcification, coronary total occlusion (CTO) in obtuse marginal (OM) 2 also critical stenosis in obtuse marginal (OM) 3 (**Figure 1**), 80% stenosis in proximal of right coronary artery (RCA), 90% stenosis in mid of RCA, 90–95% in distal of RCA, and diffuse stenosis 70–80% in distal posterolateral branch. We decided to open the stenosis in left circumflex artery (LCx).

We inserted extra backup guide catheter (EBU) 3.5/6F and performed wiring to distal OM2. We did pre-dilatation from proximal LCx to OM2 with balloon noncompliance (NC) 2.5/20 mm and inflated till at 12 atm for 12 seconds. It showed coronary perforation Ellis's classification type III (**Figure 2**). The patient complained with chest pain and we found hemodynamic instability.

We performed stenting in proximal LCX to OM2 with drug-eluting stent (DES) 2.5/28 mm inflated till at 12 atm for 30 seconds (**Figure 2A** and **2B**). After that, we performed prolonged balloon inflation (on-off) for 5 minutes (**Figure 2C** and **2D**). Nevertheless, coronary perforation Ellis's classification type III still showed.

We decided to perform stent overlapping, but the stent could not pass through the lumen. Predilation with balloon NC 2.5/20 mm inflated till 12 atm for 8 seconds was performed and finally the stent went through the lumen. We performed intrastent stenting with DES Coroflex Isar 2.5/28 mm inflated till at 10 atm for 30 seconds, followed by post-stenting dilatation that was inflated till 12 atm for 30 seconds. After that we performed prolonged balloon inflation (on-off) for 5 minutes. After we evaluated, perforation disappeared. We continued to perform predilation with balloon NC 2.5/20 mm inflated till 12 atm for 8 seconds in distal LCx. Then, performing stenting in distal LCx with DES 2.5/28 mm inflated till at 10 atm for 30 seconds, followed by post-stenting dilatation that inflated till 12 atm for 8 seconds. The final result showed no residual perforation and TIMI III flow (**Figure 2E** and **2F**). Hemodynamic was stable, no chest pain, and the patient was transferred to the intensive coronary care unit (ICCU) for monitoring.

In ICCU, we performed serial echocardiography to evaluate pericardial effusion every 2 hours. Nevertheless, there was no pericardial effusion showed in 24 hours monitoring. The patient was transferred to ward and discharged 48 hours after the procedure with no symptoms. The patient was followed up every week in the first month and no symptoms appeared. The patient was in stable condition and free of symptoms three months later.

Discussion

CAP, a rare yet concerning complication of PCI, is influenced by various factors such as patient characteristics, lesion attributes, and procedural complexities. The risk of CAP is heightened when dealing with complex lesions, including CTOs, angulated calcified type B2 and type C lesions, long lesions (>10 mm), eccentric lesions, and small vessel size [14]. Risk factors encompass conditions associated with increased calcification like diabetes, hypertension, and chronic renal failure. While females are sometimes considered more susceptible to perforation due to their smaller blood vessels, the available data are inconclusive [11]. In this particular case, the risk factors included being female, having diabetes, and dealing with a CTO.

Therapeutic approaches for CAP encompass prolonged balloon inflation, the use of covered stents, reversal of anticoagulation, embolization of the distal vessel, and surgery. The choice of treatment depends on factors such as the site and severity of the perforation, the patient's hemodynamic status, and the equipment available in the catheterization laboratory [14,15]. In this case, prolonged proximal balloon inflation (at a 1:1 balloon-to-vessel size ratio) was employed to buy time, with the potential need for multiple rounds of prolonged balloon inflation. Balloon inflations lasting up to 5-10 minutes were utilized to seal the perforation, and if sealing proved challenging, repeated inflations were performed. To prevent distal ischemia, perfusion balloons were considered without blocking distal blood flow [12,16].

The most used approaches for dealing with CAP include the insertion of polytetrafluoroethylene (PTFE) covered stents for addressing perforations in the proximal main vessel and employing distal embolization techniques for peripheral perforations. Covered stents play a crucial role as a rescue treatment for CAP, particularly when dealing with proximal

perforations occurring in vessel segments with a diameter of 2.75 mm or larger. These proximal CAPs are often the result of the excessive use of oversized or aggressive balloons or medical devices [17-19]. The primary goal of using a covered stent is to seal the perforation effectively by creating a barrier impermeable to blood. While perforations in the proximal main vessel can be successfully managed with PTFE-covered stents, our facility did not have access to PTFE-covered stents in this case. Consequently, we opted for a secondary intervention involving the implantation of a second DES to halt the coronary perforation. This approach yielded positive results.

The second DES strategy for treating CAP in the main vessel is not commonly used, primarily due to the favorable immediate outcomes associated with PTFE covered stents [20]. According to a recent survey conducted by Dr. Johnson, fewer than 1% of physicians would opt for the second DES strategy to address CAP in the proximal main vessel [21-23]. However, in a report by Strycek and colleagues in May 2023, successful treatment of CAP with a second DES was documented. While perforations in the proximal main vessel can typically be effectively treated with PTFE-covered stents, this approach may not be suitable for perforations at bifurcation sites. Attempting to implant a PTFE-covered stent in such cases could pose risks, including right ventricle infarction and inadequate stent apposition, especially if the available stent sizes are limited (e.g., the largest Papyrus stent available was 4 mm in diameter with a maximum stent expansion diameter of 4.65 mm). Furthermore, PTFE-covered stents are associated with a higher risk of stent restenosis and thrombosis, leading to suboptimal long-term outcomes. Therefore, in this case, the decision was made to implant another DES. The Synergy Megatron DES was selected for this purpose due to its advantageous characteristics, such as the highest strut density among available stents, optimized and uniform scaffolding at larger diameters, and superior radial and axial strength (facilitated by a 12-peak design), which yielded positive results [21,24,25]. This strategy was chosen because covered stents were not available at the center where the procedure was performed.

In a case report from 2021, a male patient with complex coronary anatomy had CTO in the circumflex artery. He had previously undergone angioplasty procedures in the LAD and RCA. He presented with chest pain but did not show elevated troponin levels. Angiography revealed severe in-stent restenosis in the LAD. A PCI procedure was performed in the mid LAD using 2.75×26.0 mm and 2.75×22.00 mm Onyx DES. However, this procedure led to a small, contained perforation (with no pericardial effusion) due to LAD dissection and the loss of the second diagonal artery. Overcoming significant challenges and with the aid of a Guidezilla guide extension, an overlapping stent was positioned between the patient's previous proximal and mid-vessel stents using a 2.75×22.00 mm Onyx stent and optimized with a 3.25 mm non-compliant balloon. The procedure was successful, with no pericardial effusion observed during the procedure or on subsequent repeat echocardiography [23].

In a 2013 case report, a male patient who presented with stable angina. The patient underwent coronary angiography via the right radial artery, which revealed two significant lesions in RCA and LAD. Initially, PCI was performed on the LAD using 3.0×32.0 Liberte BMS and 2.75×18 mm Nobori DES. After post-dilation with 3.5×16 Sprinter balloon at high pressure resulted in an Ellis type III perforation from beneath the overlapped region of the vessel; despite attempts with prolonged balloon inflation, continuous leakage was observed. Since a covered stent was unavailable. A 3.0×16 mm Liberte bare metal stent (BMS) was deployed at 16 atm, successfully sealing the perforation completely [18]. Covered stents have some limitations. Their bulkiness and stiffness can make it challenging to place them in distal, tortuous and calcified lesions, potentially compromising side branch flow. Additionally, covered stents have a higher risk of thrombosis due to late reendothelialization of PTFE and increased restenosis rates [18,19]. Moreover, these stents may not always be readily available for use.

Conclusion

CAP is an infrequent occurrence during PCI but it carries a substantial risk of severe health complications and even death. The choice of treatment strategy depends on various factors, including the patient's hemodynamic condition, the specific location of the CAP, the patient's coronary artery anatomy, the extent of myocardial tissue at risk, and the patient's suitability for

cardiac surgery. In certain cases, resolving a significant CAP can be effectively achieved by implanting a second DES, which may lead to a successful treatment outcome.

Ethics approval

The patient provided the written informed consent.

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Competing interests

The authors declare that there is no conflict of interest.

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Underlying data

All data underlying the results are available as part of the article and no additional source data are required.

How to cite

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