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ABOUT COVER

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CASE REPORT

Drug-coated balloons for treating *de novo* lesions in large coronary vessels: A case report

Zhi-Qiang Zhang, Yi-Ran Qin, Man Yin, Xue-Heng Chen, Lei Chen, Wen-Yan Liang, Xi-Qing Wei

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Abstract

BACKGROUND

Percutaneous transluminal coronary angioplasty, while an effective intervention, can frequently lead to acute occlusion with severe consequences. Although clinical trials have demonstrated the efficacy of drug-coated balloons (DCB) in treating acute coronary artery occlusion and in preventing restenosis, there has been limited exploration on the use of DCB in treating *de novo* lesions in large vessels. Currently, DCB are only recommended for patients with small vessel lesions and in-stent restenosis lesions, those at high risk of bleeding, and other special groups of patients.

CASE SUMMARY

This report presents a case of successful drug-coated balloon treatment of *de novo* lesions in large coronary vessels. Postoperatively, the patient demonstrated favorable recovery, with subsequent examination results revealing no significant differences from the previous examination.

CONCLUSION

The successful treatment of the patient in our case highlights the potential of DCB in the treatment of *de novo* lesions in large coronary vessels.

Key Words: Drug-coated balloons; *De novo* lesions; Large coronary vessels; Coronary artery disease; Percutaneous coronary intervention; Case report

Core Tip: Drug-coated balloons (DCB) are currently only recommended for patients with small vessel lesions and in-stent restenosis lesions, those at high risk of bleeding, and other special groups of patients. This report presents a case of successful drug-coated balloon treatment of *de novo* lesions in large coronary vessels. The successful treatment of the patient in our case highlights the potential of DCB in the treatment of *de novo* lesions in large coronary vessels.

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INTRODUCTION

Clinical trials have shown that drug-eluting stents are significantly superior to percutaneous coronary angioplasty in treating acute coronary artery occlusion and preventing restenosis[1]. However, drug-eluting stents also bring a set of new challenges, including slow endothelial repair, subacute or even late in-stent thrombosis, delayed stent malapposition, stent fracture, long-term use of antiplatelet drugs, and potential aneurysm induction[2,3]. A promising alternative approach involves delivering anti-proliferative agents to the target lesion *via* drug-coated balloons (DCB). When these balloons expand, the agents permeate the wall of the target lesions, thus blocking the intimal hyperplasia. Being absent of polymer matrix and metal network residue, DCB significantly mitigates the endothelial inflammation and thrombosis risk, while shortening the duration of dual antiplatelet therapy. Moreover, DCB treatment does require the insertion of foreign bodies, allowing for follow-up treatment if necessary[4,5]. Nonetheless, there are limited trials on the use of DCB in treating *de novo* lesions in large coronary vessels, as guideline recommendations primary centered on small vessel lesions, in-stent restenosis lesions, and bifurcation lesions[6]. While drug-eluting stents are widely used in treating *de novo* lesions in large coronary vessels, they present a heightened risk of inducing coronary artery entrapment and acute occlusion following percutaneous transluminal coronary angioplasty[7]. Therefore, here we present a case of DCB treatment of *de novo* lesions in large coronary vessels as a reference for future studies.

CASE PRESENTATION

Chief complaints

A 58-year-old male patient was admitted to our hospital, with a chief complaint of "episodic chest discomfort for 6 mo".

History of present illness

The patient's symptoms started 6 mo ago with chest tightness.

History of past illness

Despite being diagnosed with hypertension for 3 mo, with a peak blood pressure of 156/90 mmHg, the patient was not on any medication.

Personal and family history

The patient reported rare alcohol consumption, although he had a 30-year smoking history of 20 cigarettes per day.

Physical examination

Physical examination recorded the patient's blood pressure at 142/91 mmHg, and showed no obvious abnormalities in the heart, lungs, or abdomen.

Laboratory examinations

Human epididymal protein 4, carcinoembryonic antigen, alpha fetoprotein were normal on May 14, 2021, the patient's cancer antigen (CA) 125 was 392.9 U/mL and CA199 was 88.27 U/mL. Routine laboratory tests, including routine blood, liver and renal function, and lipids, blood glucose, electrolytes, cardiac enzyme, and B-type natriuretic peptide measurement, revealed no obvious abnormalities. An electrocardiogram displayed ST-T alterations, sinus bradycardia, and QS in leads V1-V3.

Imaging examinations

Cardiac ultrasound displayed abnormal left ventricular diastolic function with an ejection fraction of 62%.

FINAL DIAGNOSIS

The patient was diagnosed with coronary artery disease, sinus bradycardia, and grade 1 hypertension, categorized as very high risk. Symptomatic treatments, including antiplatelet therapy, lipid modification and plaque stability, acid suppression, and gastrointestinal protection, were administered. Acute pericarditis, intercostal neuralgia, and cardiac neurosis were also considered in the differential diagnosis.

TREATMENT

After ruling out any contraindications, coronary angiography was performed on February 19, 2021. The results revealed a right coronary predominance, no significant stenosis in the left main stem, 99% stenosis in the left anterior descending branch (LAD) arising from the first diagonal branch with TIMI grade I antegrade flow (Figures 1A and B), and no significant stenosis in the left circumflex branch with TIMI grade III. Coronary artery disease was confirmed during the operation. After discussing with a family member, we proceeded with the percutaneous coronary intervention (PCI). A 6F guiding catheter was positioned in the left coronary port. An Anyreach C guiding wire (EPT, China) was advanced to the distal end of the first diagonal branch, while an attempt to deliver an SION blue guiding wire (Asahi, Japan) to the distal part of LAD was unsuccessful. Consequently, the SION blue guiding wire was positioned at the distal end of the left circumflex branch and the LAD. A 2.0 mm × 20.0 mm balloon (Hengyi, China) was inflated with 16 atm × 10 s pressure; a 3.5 mm × 10 mm cutting balloon (Boston, United States) was inflated with 8 atm × 10 s pressure. Subsequent repeat imaging revealed satisfactory pre-dilatation results (Figure 1C). A 3.5 mm × 25 mm DCB (Braun, Germany) was then inflated with 10 atm × 60 s pressure (Figure 1D). Repeat imaging revealed no entrapment, no aneurysm, no thrombosis, and 20% residual stenosis (Figures 1E and F). During the procedure, a total of 8500 U of heparin was administered; 3000 U of heparin was administered for successful puncture and 5500 U of heparin was administered before treatment. The patient reported no particular pain during or after the procedure.

OUTCOME AND FOLLOW-UP

The patient returned for a follow-up visit at the hospital on December 19, 2021. There were no significant laboratory abnormalities or reports of significant pain. Cardiac ultrasonography revealed reduced left ventricular diastolic function with a 62% ejection fraction, mild enlargement of the left atrium, and dilation of the ascending aorta. Coronary computed tomography angiography (CTA) showed a right dominant coronary artery, non-calcified plaque, and mild luminal stenosis in the proximal segment of LAD, with a stenosis of about 30% (Figure 2). Additionally, a myocardial bridge in the middle segment of the LAD (of the incomplete type) was detected. The patient's review results revealed minimal changes since the operation.

DISCUSSION

PCI is a foundational therapy for coronary heart disease. However, the increasing application of stents has led to the significant issue of in-stent restenosis[8,9]. The existing treatment options for in-stent restenosis have their own limitations[10]. As a novel interventional technique, DCB has gained popularity in the field of coronary artery and peripheral interventions in recent years, achieving "intervention without implantation"[11,12]. The emergence of DCB has introduced more alternatives for treating coronary artery disease[13]. At present, there are few studies exploring the treatment of *de novo* lesions in large coronary vessels. According to current guidelines, DCB is primarily recommended for treating in-stent restenosis lesions and small vessel lesions[14]. Rosenberg *et al*[15] observed no significant differences in cardiovascular events between groups with large-vessel *de novo* lesions and small-vessel *de novo* lesions treated with DCB, after 9 mo of follow-up. Neither group had cardiogenic death, myocardial infarction, or target artery thrombosis. In this case report, the evaluation results of coronary CTA following the treatment of *de novo* lesions in large coronary vessels with DCB were similar to those of PCI outcomes. Therefore, we concluded that DCB treatment is safe and offers a favorable prognosis in treating *de novo* lesions in large coronary vessels.

Pre-dilation is the most important factor that needs to be considered when treating coronary arteries[16]. To prevent the requirement of dissection during semi-compliant balloon dilation, the ratio of the balloon and vessel diameter should be between 0.8 and 1.0[17]. Non-compliant balloons or cutting balloons can be used for appropriate pre-dilation in cases with severe residual stenosis, but the cutting balloons must be progressively compressed and released. Pre-dilation can facilitate the procedure and ensure successful outcomes, especially when using the cutting balloons and vibrating balloons. These balloons can address severe calcified lesions, prevent elastic retraction, enable more thorough dilation, and ensure longer-lasting surgical effects in *de novo* large vessel lesions. In order to minimize the risk of coronary artery entrapment, it is critical to position the cutting balloon uprfront during the procedure. Following pre-dilatation, DCB therapy can be initiated if the following conditions are met: Residual stenosis is below 30%; the TIMI blood flow level is grade 3; and there is no dissection of type C or more severe types[4]. If a dissection of type C or higher does occur, immediate placement of a remedial stent is necessary. The procedure should not proceed if a type A or type B dissection is present without any progress in the dissection after 10-15 min of observation on the operating table[18]. The benefits of

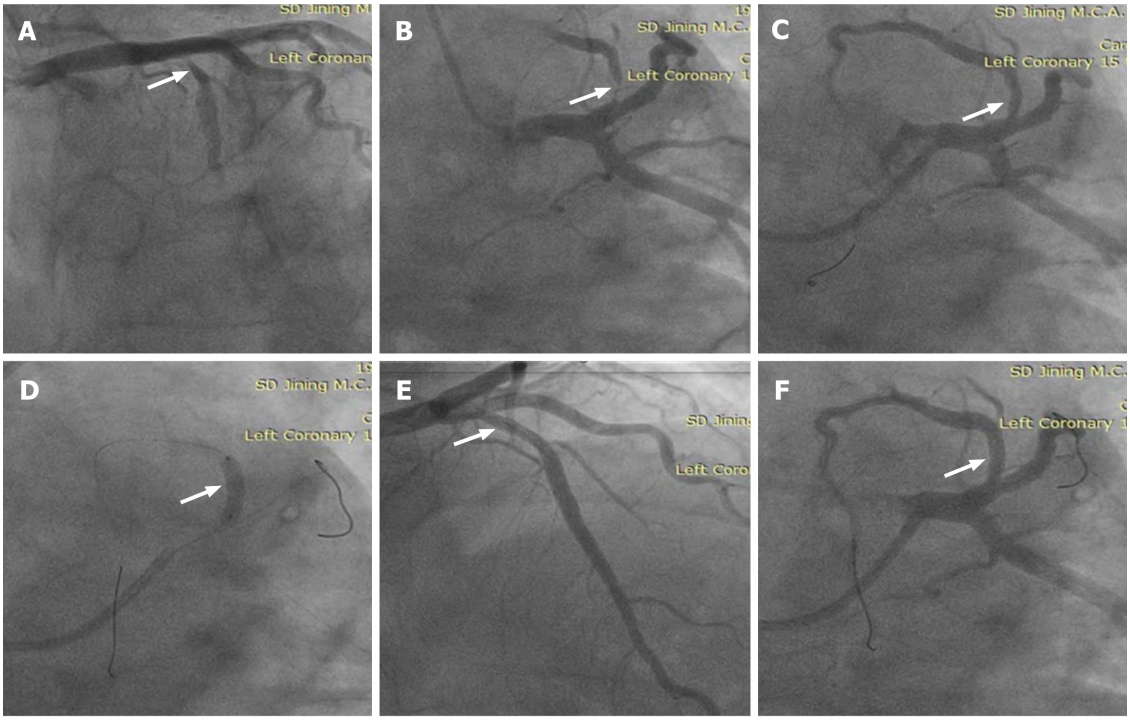

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Figure 1 Left anterior descending coronary artery angiography and treatment results. A: Before percutaneous coronary intervention (PCI), 99% stenosis was found in the first diagonal branch of the left anterior descending branch (LAD) in the cranial position; B: LAD angiography in spider position before PCI; C: Image comparison before and after pre-dilatation; D: Drug-coated balloon release image; E: LAD angiography in the cranial position showing 20% residual stenosis after PCI; F: Result of LAD angiography in spider position after PCI. Arrows indicate the lesion.

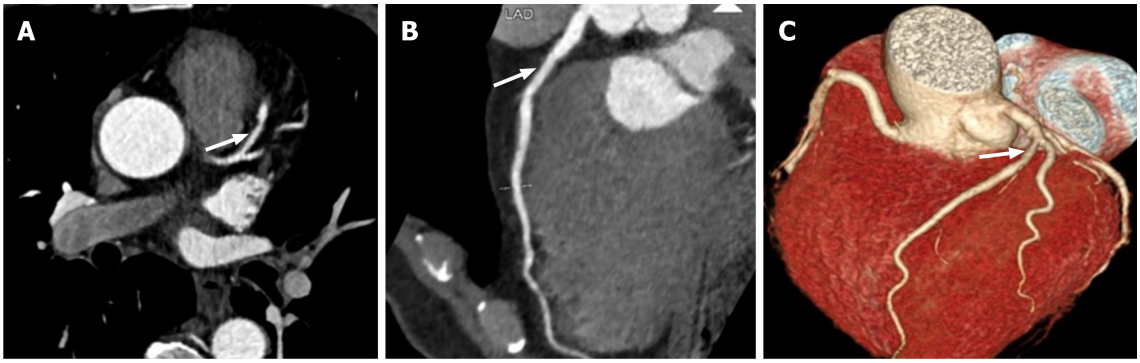

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Figure 2 Coronary computed tomography angiography results. A: Axial image; B: Curved planar reconstruction image of the left anterior descending branch (LAD); C: Volume rendering technique image of LAD. Arrows show the lesion.

DCB therapy over drug-eluting stents are as follows: (1) The absence of polymer or metal mesh minimizes endothelial inflammatory response and lowers the risk of thrombosis; (2) The duration of dual antiplatelet therapy can be shortened to only 1-3 mo, making it a feasible option for patients at high risk of bleeding[19]; (3) DCB prevents the implantation of foreign bodies, leaving the possibility open for subsequent treatments if necessary; and (4) The psychological impacts on patients who are averse to stent insertion can be mitigated[17].

CONCLUSION

In summary, our case illustrated the successful application of DCB to treat *de novo* lesions in large coronary vessels. Follow-up evaluations confirmed the safety, efficacy, and favorable outcomes associated with DCB. Although there is a lack of extensive data supporting the use of DCB for the treatment of *de novo* lesions in large coronary vessels, our case report and the potential benefits justify their application in the specific patient group as outlined in this report.

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FOOTNOTES

Author contributions: Zhang ZQ and Qin YR drafted, reviewed, and revised the manuscript; Wei XQ was the primary physician during the patient's inpatient stay; Yin M, Chen L, and Liang WY acquired and analyzed all the clinical data; and all authors have read and approved the final manuscript.

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