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Case Reports

Sustained Lumen Area by Paclitaxel-Coated Balloon Following Rotational Atherectomy for Napkin-Ring Left Main Trunk Ostial Lesion

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Abstract

Late lumen enlargement after percutaneous coronary intervention (PCI) with drug-coated balloon has contributed to good clinical results. However, late lumen enlargement with drug-coated balloon following rotational atherectomy has not been well reported. This report describes a case of calcified napkin-ring ostial lesion at the left main trunk that showed a sustained lumen area after PCI with drug-coated balloon following rotational atherectomy. An 85-year-old female patient was admitted to the hospital with dyspnea. Echocardiography showed hypokinesis in the anteroseptal and inferior walls. Electrocardiograph-gated cardiac computed tomography showed a calcified ostial lesion in the left main trunk. Invasive angiography of the coronary artery showed severe stenosis in the left main trunk ostium. Percutaneous coronary intervention was performed with a drug-coated balloon after rotational atherectomy. The minimal lumen area measured by intravascular ultrasound grew mildly from 4.09 to 4.17 mm^2 immediately after PCI. Follow-up angiography and intravascular ultrasound performed after 6 months showed that the minimal lumen area in the left main trunk ostium was further enlarged from 4.17 to 4.69 mm^2. The presence of sustained lumen area after PCI with drug-coated balloon following rotational atherectomy for a napkin-ring left main trunk ostial lesion was confirmed. This case demonstrates sustained lumen area after drug-coated balloon following rotational atherectomy in the left main trunk ostium, improving the patient's chest symptom. Hence, drug-coated balloon after rotational atherectomy may be an option for complex stent sites, such as the left main trunk ostium in geriatric patients and sites with highly calcified lesions.

Keywords: Atherectomy; coronary artery disease; percutaneous coronary intervention

Introduction

Rotational atherectomy is a recently established procedure for calcified plaque debulking. Most calcified lesions are treated by stenting following rotational atherectomy. However, percutaneous coronary intervention (PCI) with a drug (paclitaxel)–coated balloon (DCB) is a well-established stentless strategy for in-stent restenosis and small vessel disease. The use of DCB could cause an increase in the late lumen area in the chronic phase without extensive dissection and recoil.[1] Late lumen enlargement (LLE) after PCI with DCB has contributed to good clinical outcomes.[1,2] Although these 2 strategies (rotational atherectomy and DCB) each have advantages, LLE with DCB following rotational atherectomy for severely calcified lesions has not been well reported.

This report describes a case of napkin-ring calcified ostial lesion at the left main trunk (LMT) that showed sustained lumen area confirmed by intravascular ultrasound (IVUS) after PCI with rotational atherectomy and DCB.

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Case Report

An 85-year-old female patient was admitted to the hospital because of dyspnea on exertion in March 2020. The patient reported no medical history except rheumatoid arthritis and glaucoma. She had no cardiovascular risk factors. On initial physical examination, her blood pressure was 116/64 mm Hg, heart rate was 81 beats per minute, respiratory rate was 12 breaths per minute, pulse oximetric oxygen saturation was 98% on room air, and body temperature was 36.6 °C. The patient's height and weight were 140.0 cm and 34.8 kg, respectively. Examination of her cardiovascular system revealed no abnormal murmurs, and lung sounds were clear. Her jugular venous pressure was not elevated, and she did not exhibit heart failure symptoms, such as shortness of breath or leg edema.

An electrocardiogram showed atrial fibrillation at 75 beats per minute, horizontal ST depression, and negative T wave in the V_4, V_5, and V_6 leads. Transthoracic echocardiography revealed hypokinesis in the anteroseptal and inferior walls with an ejection fraction of 54%. Electrocardiograph-gated cardiac computed tomography revealed a stenotic calcified ostial lesion at the LMT (Fig. 1A and 1B). Hence, invasive coronary angiography (CAG) was performed (Fig. 2A), revealing severe stenosis of the LMT ostium, wherein a 5F diagnostic catheter could be wedged into the LMT ostium.

Abbreviations and Acronyms

CAG	coronary angiography
DCB	drug-coated balloon
LLE	late lumen enlargement
LMT	left main trunk
MLA	minimal lumen area
PCI	percutaneous coronary intervention

Ischemic functional evaluations, including single-photon emission computed tomography or fractional flow reserve, were not performed. The electrocardiogram showed no abnormal Q waves, and the myocardium appeared to be viable.

Percutaneous coronary intervention was planned for the LMT ostial lesion, considering the patient's Synergy Between Percutaneous Coronary Intervention With TAXUS and Cardiac Surgery (SYNTAX) score of 20, advanced age, and frailty. Intra-aortic balloon pump insertion was performed before PCI. A 7F Glidesheath Slender (Terumo) was inserted into the right radial artery. Percutaneous coronary intervention was then performed using a 7F JL 3.5 guide catheter. The LMT and left anterior descending artery were crossed with the guide wire (ASAHI SION blue; ASAHI Intecc). Intravascular ultrasound (OptiCross Imaging Catheter; Boston Scientific) examination was performed from the left anterior descending artery to LMT ostium, which showed a highly calcified lesion with a calcium

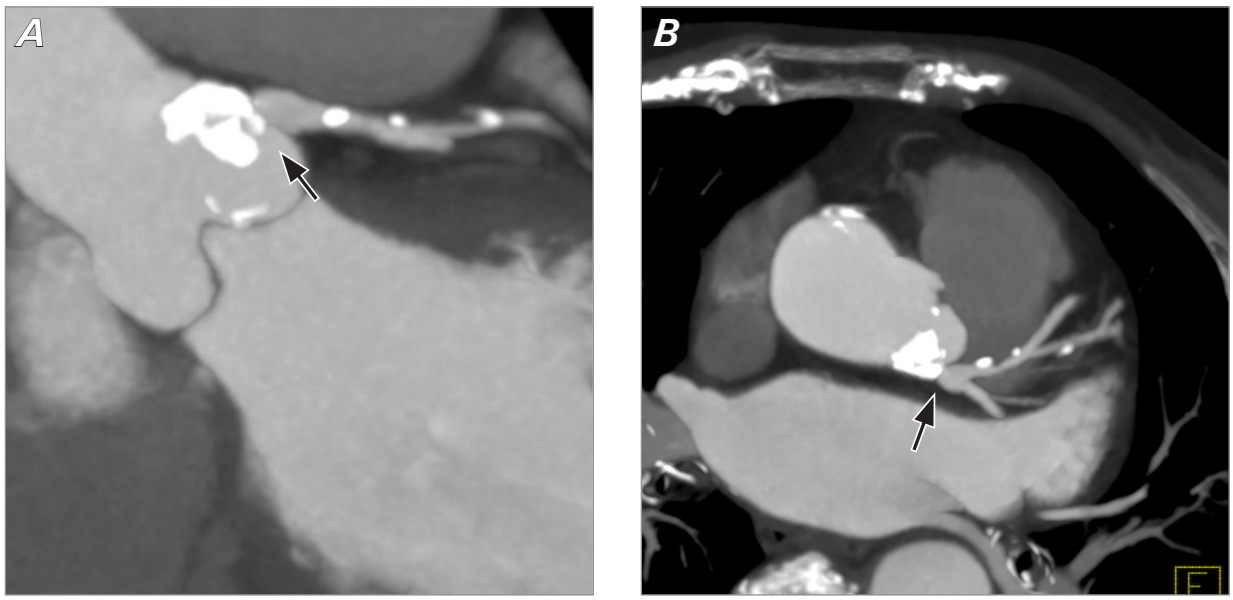

Fig. 1 Electrocardiograph-gated cardiac computed tomogram reveals severe stenosis in the calcified ostial lesion at the left main trunk (arrows) in **A)** coronal and **B)** axial views.

arc of 360°, that is, "napkin ring" (Fig. 2B). Therefore, rotational atherectomy (Rotalink Plus, 1.5-mm and 2.0-mm burrs; Boston Scientific) was performed and a cutting balloon (Wolverine Cutting Balloon, 3.0/10 mm; Boston Scientific) was inflated. Thrombolysis in Myocardial Infarction flow grade 3 and the absence of a flow-limiting dissection were confirmed. Hence, a DCB (SeQuent Please, 3.5/15 mm; B. Braun) was inflated in the LMT ostium owing to the possibility of aortic dissection by pressure expanding metallic stent or stent edge exiting into the aorta. The minimal lumen area (MLA) was mildly enlarged from 4.09 to 4.17 mm^2 after PCI, and the 7F guide catheter was no longer wedged into the LMT ostium (Fig. 3A and 3B). A staged PCI was scheduled with a rotational atherectomy and drug-eluting stent, using a larger burr size (≥2.15 mm) with PCI, if necessary, at follow-up CAG.

In October 2020, follow-up CAG showed no restenosis in the LMT ostium (Fig. 4A). Intravascular ultrasound examination confirmed sustained lumen area of the LMT ostial lesion. The MLA in the LMT ostium was enlarged to 4.69 mm^2, compared with 4.17 mm^2 after the previous PCI (Fig. 4B). Although other factors, including differences in catheter position for each procedure, might be related, the sustained left main result (LLE, based on the numerical value) after PCI with DCB following rotational atherectomy for a napkin-ring LMT ostial lesion was verified. This MLA is acceptable for a smaller Asian woman, such as the patient in the present case (height of 140 cm and weight of 34.8 kg), according to the 2018 European Society of Cardiology/European Association for Cardio-Thoracic Surgery Guidelines on myocardial revascularization.[3] Therefore, the choice was made to defer further PCI with additional rotational atherectomy. The patient has remained free of chest pain for 10 months from the procedure.

Discussion

Late lumen enlargement with DCB following rotational atherectomy for severe calcified ostial lesions has not been well reported. This article reports a case of sustained lumen area confirmed by IVUS after PCI with rotational atherectomy and DCB for a napkin-ring LMT ostial lesion.

A growing body of evidence suggests that the efficacy of DCB for the treatment of in-stent restenosis or small vessel disease has been established.[4-7] However, there are

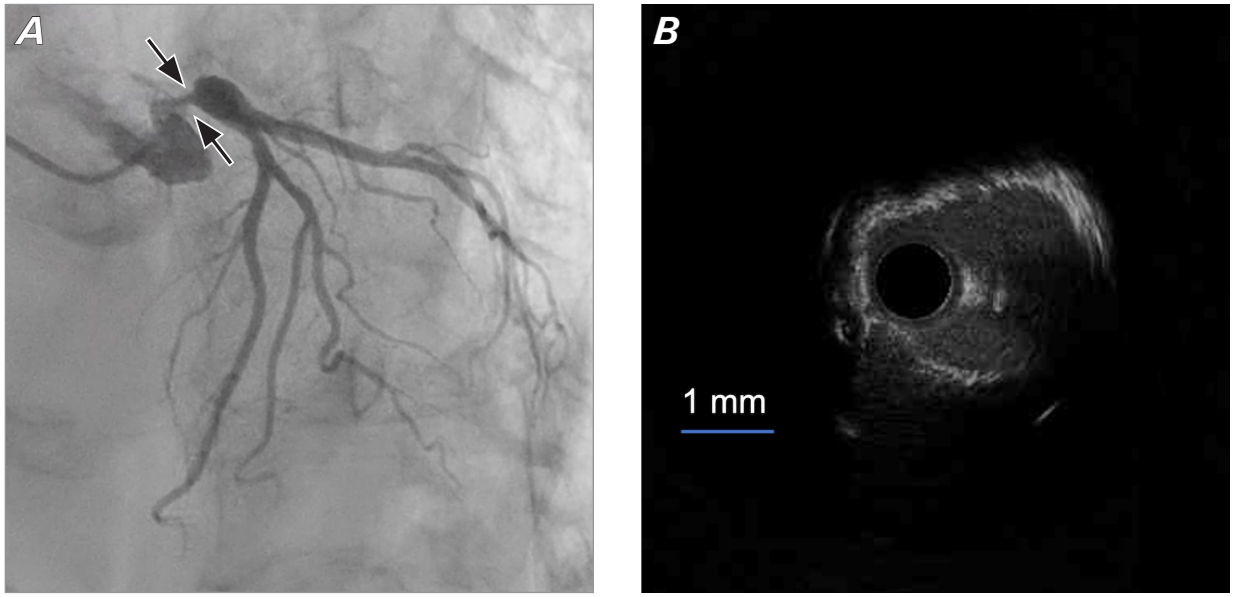

Fig. 2 Angiogram of the coronary artery and intravascular ultrasound before the procedure. **A)** Pre-PCI angiogram (left cranial view) demonstrates severe stenosis of the LMT ostium (arrows). The supplemental motion image also shows severe stenosis lesion at the LMT. **B)** Pre-PCI intravascular ultrasound at the LMT ostium shows a minimal lumen area of 4.09 mm^2.

Supplemental motion image is available for Figure 2.

LMT, left main trunk; PCI, percutaneous coronary intervention.

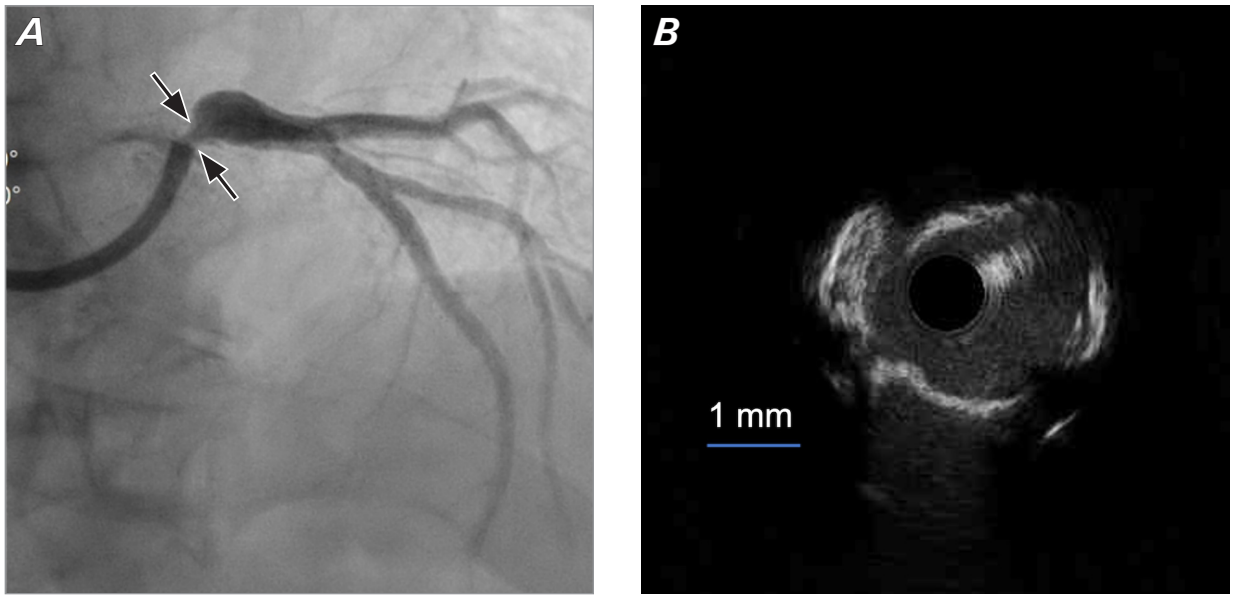

Fig. 3 Angiogram of the coronary artery and intravascular ultrasound immediately after the procedure. **A)** Post-PCI angiogram (left cranial view) indicates a mildly enlarged lesion at the LMT (arrows). There was a coronary dissection (National Heart, Lung, and Blood Institute coronary dissection criteria type A) at the LMT without flow limit. The supplemental motion image also shows the lesion following the procedure. **B)** Post-PCI intravascular ultrasound at the LMT ostium shows a minimal lumen area of 4.17 mm^2.

Supplemental motion image is available for Figure 3.

LMT, left main trunk; PCI, percutaneous coronary intervention.

limited data regarding its efficacy for calcified lesions. A previous trial that used DCB for the treatment of calcified lesions showed comparable late lumen loss and restenosis rates between calcified and noncalcified lesions.[8] Rissanen et al[9] reported outcomes of 65 patients with calcified lesions treated with DCB following rotational atherectomy, who showed low rates of major adverse cardiovascular events and target-lesion revascularization. In a study by Nagai et al,[10] approximately 39% of lesions showed LLE after PCI with rotational atherectomy and DCB. There were no cardiac deaths, and the target lesion revascularization rate was 16.4% during the midterm follow-up. Drug-coated balloon after rotational atherectomy seems to be a feasible and safe procedure.

In this case, rotational atherectomy and cutting balloon modified the napkin-ring calcified lesion, and paclitaxel might have penetrated easily. Although little is known about how paclitaxel works on calcium to modify calcified lesions, there are several reports of paclitaxel action on vascular calcification. Shimizu et al[11] reported vascular calcification closely related to morphogenic protein signaling and gene regulators of osteogenesis, such as the *Msx2* gene and osteoprotegerin. Also, apoptosis of smooth muscular cells and release of matrix vesicles are important factors in coronary artery calcification.[12] Paclitaxel attenuates differentiation of vascular smooth muscle cells into osteoblast, that is, vascular calcification by downregulation of osteogenic signal and inhibiting matrix vesicle release.[13]

Stent implantation in severely calcified lesions is associated with worse outcomes owing to defective stent expansion and strut apposition.[14-16] A previous randomized trial found that postprocedural stent asymmetry was associated with 1-year ischemic events.[17] In this case, the disadvantages of stent implantation at calcified LMT ostial lesion included the possibility of inadequate dilation, the risk of aortic dissection by pressure expanding the metallic stent, the possibility of stent edge exiting into the aorta, and the inability to perform a second PCI with rotational atherectomy. Although the mechanism of LLE in severe calcified lesion by paclitaxel is not fully understood, further study should be undertaken to confirm the utility of a paclitaxel-eluting balloon for very severe calcified coronary artery lesions instead of deploying stents.

The 2018 European Society of Cardiology/European Association for Cardio-Thoracic Surgery Guidelines

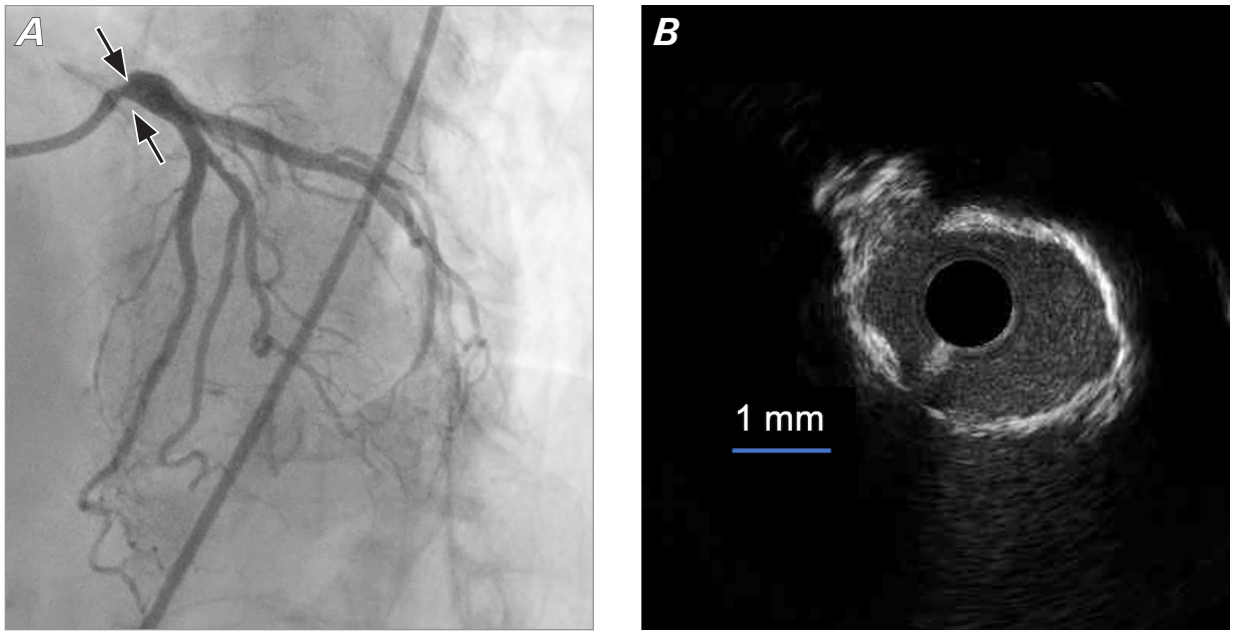

Fig. 4 Follow-up angiogram of the coronary artery and intravascular ultrasound. **A)** Follow-up angiogram shows no restenosis in the LMT ostium (arrows). The supplemental motion image also shows the follow-up angiography of the lesion. **B)** Follow-up intravascular ultrasound at the LMT ostium shows a minimal lumen area of 4.69 mm^2.

Supplemental motion image is available for Figure 4.

LMT, left main trunk.

on myocardial revascularization state that "in Asian patients with generally smaller heart sizes, studies have suggested that an IVUS MLA of 4.5-4.8 mm^2 may be the most appropriate."[3] Therefore, the MLA of 4.69 mm^2 in this case is within the recommended range.

Conclusion

In this patient, paclitaxel-coated balloon after rotational atherectomy for napkin-ring calcified ostial lesion resulted in a sustained lumen area in the chronic phase. This treatment option might be considered for lesions that are not suitable for stent implantation, such as severe calcified LMT ostium.

A small advantage of LLE was seen after local delivery of paclitaxel in a calcified lesion in the present case. Future investigation is needed to clarify the mechanism of paclitaxel on calcified lesions, which may provide a treatment option for severe calcified coronary artery disease.

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