Use of orbital atherectomy in acute myocardial infarction via the transradial approach

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Abstract: Severe coronary artery calcifications pose an ongoing challenge when performing percutaneous coronary interventions, resulting in an increased likelihood of procedural complications. Orbital atherectomy (OA) has emerged as a promising technology that helps improve outcomes in this complex patient population. Its safety and efficacy are yet to be demonstrated in the setting of acute myocardial infarction. We present a case of a patient with acute ST-elevation myocardial infarction (STEMI) evaluated with emergent transradial coronary angiography. The culprit lesion was a severely stenotic, heavily calcified, segment of the right coronary artery. The use of OA facilitated lesion expansion and implantation of a drug-eluting stent. Although OA should be considered as contraindicated for the management of soft-ruptured plaque, which accounts for the majority of STEMI presentations, it may be well applied to the small subset of patients with calcified nodule pathology, even in the acute setting.

Keywords: coronary artery calcification, orbital atherectomy, ST-elevation myocardial infarction, transradial angiography, percutaneous coronary intervention, calcium, vessel preparation

Introduction

Severe coronary artery calcifications (CACs) present an ongoing treatment challenge despite the advent of various technologies for plaque debulking and reducing atherosclerotic burden prior to stent implantation. The Diamondback 360® Coronary Orbital Atherectomy (OA) System (Cardiovascular Systems Inc., St. Paul, MN, USA) has demonstrated both safety and efficacy by facilitating stent delivery in patients with severely calcified coronary artery plaque [1]. In addition, the device is compatible with smaller sized guide catheters and its use has been shown to be safe and feasible via the transradial approach [2]. Patients with acute coronary syndrome (ACS), however, have been excluded from these studies, and the utility of OA is yet to be shown in this group of acutely ill patients with a high potential for thrombus load. We present a case in which OA was used to facilitate stent implantation in a patient with acute ST-elevation myocardial infarction (STEMI) evaluated with emergent transradial coronary angiography. To the best of our knowledge, this is the first reported case of successful use of OA via the transradial approach in the setting of acute STEMI.

Case Report

A 65-year-old female presented to the emergency room with a 3-day history of intermittent chest pain that acutely worsened. The patient was a daily smoker and was known to have type 2 diabetes mellitus. Diagnosis of inferior STEMI was made based on electrocardiographic findings. The patient was pretreated with aspirin, ticagrelor, and heparin. Emergent transradial coronary angiography was performed via a hydrophilic coated 25 cm 6 Fr right radial sheath. Angiography showed a mid-left anterior descending (LAD), 80% stenosis but the culprit lesion was identified as a heavily calcified, 99% stenosis in the mid-segment of the right coronary artery (RCA) *(Fig. 1A)*. The decision was made to proceed with percutaneous coronary intervention (PCI) and the RCA lesion was crossed using a Whisper guide wire. Balloon

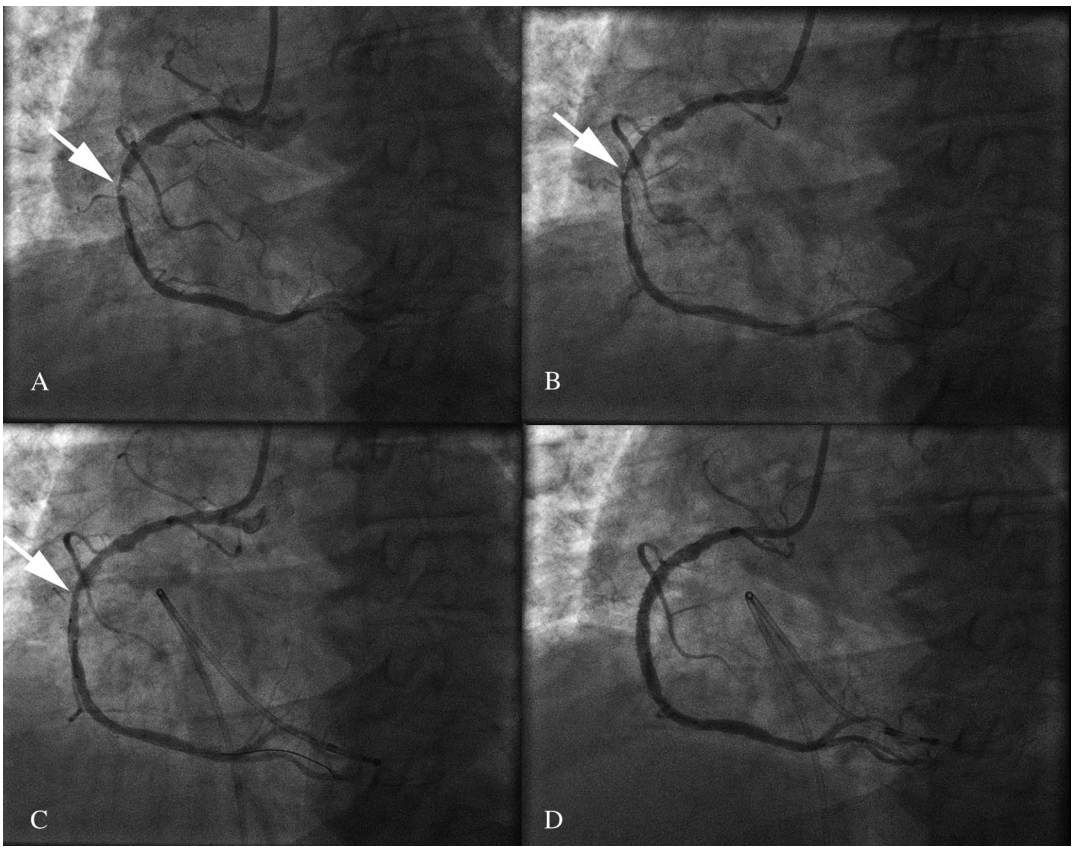

Fig. 1. (A) Coronary angiography showing a heavily calcified, 99% stenosis of the mid RCA (arrow). (B) Inadequate lesion dilatation (arrow) following balloon angioplasty. (C) Improved angiographic appearance of lesion (arrow) following orbital atherectomy. (D) Final angiographic result following stent implantation.

angioplasty was attempted with a MINI TREK II OTW balloon (2.00 × 15 mm) without adequate lesion dilatation; there was no angiographic evidence of dissection *(Fig. 1B)*. Therefore, the Diamondback 360® Coronary OA System was used to facilitate lesion preparation prior to stent deployment. The guide wire was exchanged for a ViperWire Advance® using the OTW balloon. A temporary transvenous pacing wire was placed via the right femoral vein due to the risk of developing high-grade atrioventricular block during RCA atherectomy. OA was then performed using multiple slow passes of a 1.25 mm crown both at low and high rotational speeds, achieving improved angiographic appearance *(Fig. 1C)*. The diseased segment was then successfully pre-dilated with a 3.0 × 15 mm Euphora balloon and a XIENCE Alpine RX drug-eluting stent (3.25 × 33 mm) was deployed. Post-dilatation was then accomplished with non-compliant Euphora RX (3.25 × 12 mm) and non-compliant Emerge MR (3.5 × 8.0 mm) balloons. Thrombolysis in myocardial infarction (TIMI) 3 flow was achieved at the end of the procedure *(Fig. 1D)*. There were no procedural complications and the patient was discharged 2 days later. The patient returned electively a month later and underwent successful transradial optical coherence tomography (OCT)-guided PCI of the mid-LAD stenosis.

Discussion

The present case illustrates the successful use of OA for the preparation of a heavily calcified lesion prior to stent implantation in the setting of acute STEMI via the transradial approach.

Presence of significant CAC, although underestimated by conventional angiography, is common [3]. Advanced age, diabetes mellitus, and renal failure are well-known risk factors for CAC [4]. Treatment of coronary artery lesions where significant calcifications are present is associated with a higher incidence of non-Q-wave myocardial infarction [5]. Furthermore, PCI in such lesions is also associated with higher rates of restenosis and target lesion revascularization [6], partly due to the increased likelihood of incomplete stent apposition to the vessel wall and suboptimal stent expansion [7]. Rotational atherectomy (RA) has been adopted as a tool for preparation of heavily calcified coronary lesions prior to stent implantation. Prior studies have shown that RA improves procedural success, although without reduction in rates of restenosis [8]. The Diamondback 360® Coronary OA System has emerged as an alternative to RA and is currently approved for the treatment of severely calcified coronary lesions by the U.S. Food and Drug Administration based on the

outcomes of clinical trials [1, 9, 10]. The OA system uses an eccentrically mounted, diamond-coated "crown" that rotates over an atherectomy guide wire such that centrifugal forces lead to an orbital intracoronary motion with a luminal gain diameter proportional to the rotational speed. Consequently, the 1.25 mm crown can be used to treat calcified vessels with a diameter of up to 4.0 mm while maintaining compatibility with a 6 Fr guide catheter and allowing for radial access intervention even in larger coronary vessels [11].

The feasibility of the OA system via the transradial approach is demonstrated both in our patient as well as in a previously reported case series by Ruisi et al. [2]. Although RA is relatively contraindicated in the setting of acute STEMI due to the concern of triggering platelet activation or causing distal embolization in the presence of thrombus, its successful use has been reported previously [12–14]. Similarly, the use of OA is contraindicated when angiographic evidence of thrombus is present [11]. Nonetheless, recent studies of morphological coronary characterization in patients with ACS using OCT have increased awareness of the fact that in addition to plaque rupture and erosion, calcified nodules are associated with a previously underestimated proportion of ACS presentations [15]. The calcified nodule lesions are associated with diameter stenoses similar to plaque rupture lesions but a higher proportion of white thrombus rather than the heavy burden of red thrombus associated with plaque rupture. To our knowledge, there have been no prior reported cases of transradial OA being used in the setting of acute STEMI. In our patient, adequate lesion dilatation could not be achieved with balloon angioplasty *(Fig. 1B)* so further preparation of the calcified plaque was necessary. Successful lesion debulking was achieved with the use of OA that facilitated subsequent implantation of a drug-eluting stent.

Conclusion

This case demonstrates the safe transradial use of OA for treatment of a heavily calcified lesion in the setting of acute STEMI with the use of modern oral antiplatelet therapy. Although OA should be considered as contraindicated for the management of soft-ruptured plaque, which accounts for the majority of STEMI presentations, its use should be considered in patients with acute myocardial infarction due to calcified lesions with low thrombotic burden to facilitate optimal treatment.

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