Rotational Atherectomy to Facilitate Stent Expansion After Deployment in ST-segment-elevation Myocardial Infarction

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We describe successful rotational atherectomy performed in the setting of two relative contraindications to the procedure. A 77-year-old female presented with ST-segment-elevation myocardial infarction due to 100% right coronary artery thrombosis. With high pressure dilatation (22 atmospheres) and cutting balloon angioplasty, the lesion dissected but did not fully dilate. After stenting and high-pressure post-dilatation at 25 atmospheres the dissection resolved, but a 70% waist remained. Rotational atherectomy allowed full dilatation of the lesion at 22 atmospheres. In this case, after stenting removed angiographically evident thrombus and dissection, rotational atherectomy effectively and safely treated residual stenosis at an undilatable lesion.

Percutaneous rotational coronary atherectomy (PRCA) facilitates stent delivery in diffuse, complex, heavily calcified lesions.[1] In patients with acute coronary syndromes and especially in acute myocardial infarction (MI), PRCA may cause distal embolization of thrombus resulting in slow-flow or no-reflow.[2,3] In patients with spontaneous or iatrogenic dissection, PRCA may cause perforation or extension of the dissection. Thus, PRCA is generally avoided in lesions that are thrombotic or dissected. In this article we report a patient with both thrombus and dissection at the culprit site, where PRCA facilitated safe and effective dilatation of a previously non-dilatable lesion.

Case Report

A 77-year-old female with hypertension, hyperlipidemia, prior stroke, and stage 3 chronic kidney disease presented with chest pain intermittently for four days, acutely worse for the past four hours. The pre-hospital 12-lead electrocardiogram showed inferior ST elevation. Aspirin, oxygen, morphine, and nitrates were given. The patient was brought directly to the cardiac catheterization laboratory from the ambulance.

Diagnostic left arteriography showed no severe disease. Left ventriculography demonstrated inferior hypokinesis and ejection fraction of 55%. A 6-French Judkins right guide catheter (Medtronic, Santa Rosa, CA) was used to demonstrate 100% right coronary stenosis with thrombolysis in myocardial infarction (TIMI) 0 flow (see *Figure 1*). Intravenous bivalirudin 0.75mg/kg bolus was given and an infusion was started at 1.75mg/kg/hour.

A 0.014 Asahi soft wire (Abbott, Santa Rosa, CA) easily crossed the stenosis, immediately producing TIMI I–II distal flow and dramatic improvement in ST-segment elevation on the hemodynamic monitor. Manual aspiration was attempted with an aspiration catheter (Volcano Corporation, San Diego, CA), but no thrombus was obtained and the appearance and flow in the vessel were unchanged. A 3.5x15mm non-compliant (NC) Sprinter balloon (Medtronic) easily crossed the lesion (with door-to-balloon time of 28 minutes). At 22 atmospheres a waist remained and a distal dissection developed. Both 3x15mm and 3.5x15mm cutting balloons (Boston Scientific, Maple Grove, MN) inflated to 12 atmospheres could not fully expand and did not improve the appearance of the lesion (see *Figure 2*). Rotational atherectomy was considered but was not performed due to the presence of a distal dissection and possible residual thrombus. A 3.5x38mm Multi-Link Zeta bare-metal stent (Abbott) deployed at 20 atmospheres

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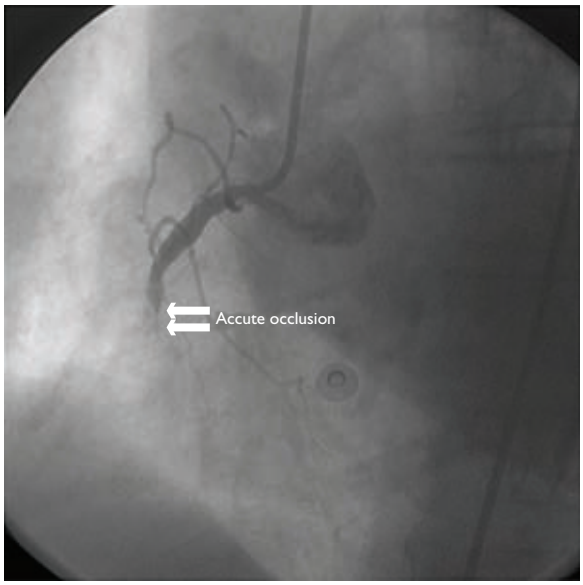
Figure 1: Right Coronary Artery with Total Occlusion Causing ST-segment-elevation Myocardial Infarction



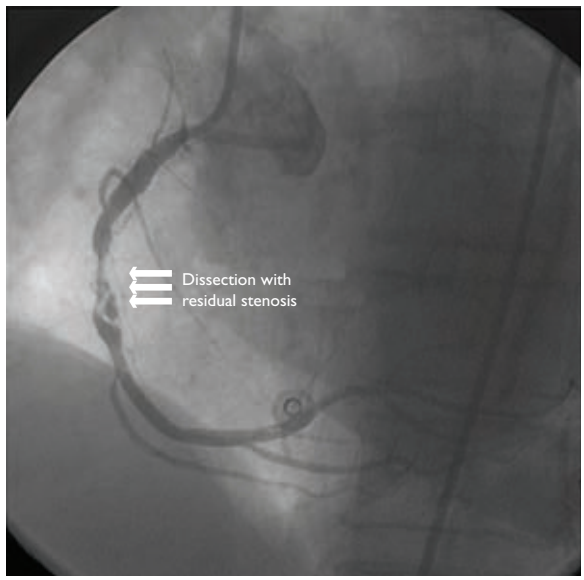
Left anterior oblique view.

retained a waist in the proximal end of the stent. To fully cover the remaining lesion proximal to this stent, a 4x18mm Driver bare-metal stent (Medtronic) was deployed at 18 atmospheres, overlapping the segment of the previous stent containing the waist. The waist remained unchanged. During post-dilatation with a 4x12mm NC Sprinter (Medtronic), the balloon ruptured at 25 atmospheres. The appearance of the vessel remained unchanged (see *Figure 3*).

The 6-French sheath was replaced by an 8-French sheath. Rotational atherectomy was performed using the 2mm Rotablator burr (Scimed, Boston Scientific Corporation, Maple Grove, MN) through an 8-French Judkins right 4 side-hole catheter (Medtronic) over a 0.014 Rotafloppy wire (Boston Scientific) (see *Figure 4*) at 180,000 revolutions per minute (rpm), keeping drops in rpms under 3,000 and run lengths under 20 seconds. Bradycardia was treated with atropine 0.5mg. The device crossed the lesion on the fifth run, followed by two polishing runs. A 4x12mm NC Sprinter (Medtronic) was slowly inflated until the waist suddenly relaxed at 20 atmospheres. After post-dilatation of the entire stented segment at 20 atmospheres, residual stenosis was 10% (see *Figure 5*). The atherectomized area was not stented since doing so would have created a 'triple-decker' stent segment.

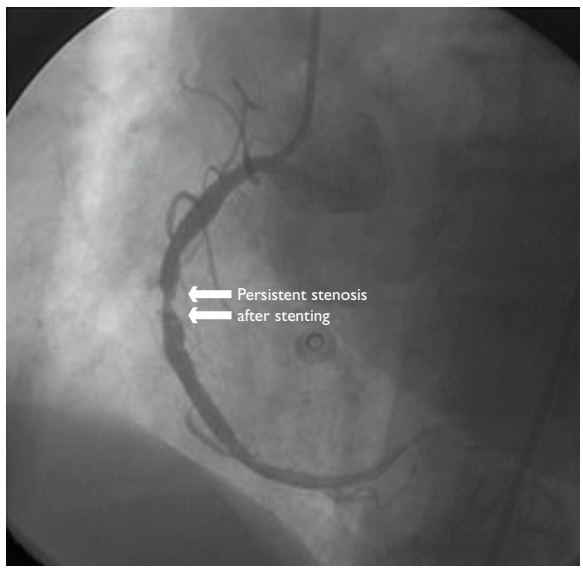
Cardiac biomarkers drawn before coronary intervention were normal, and peaked six hours later with creatine kinase 1,096U/l (normal range 24–225), creatine kinase-MB 86ng/ml (normal range 0.0–9.0), and troponin T 4.98ng/ml (normal <0.1). Echocardiography the next day showed inferobasilar akinesis and overall ejection fraction

Figure 2: Right Coronary Artery After Aspiration with a Manual Aspiration Catheter, and Angioplasty with a 3.5mm Non-compliant Balloon to 22 Atmospheres, a 3mm Cutting Balloon to 12 Atmospheres, and a 3.5mm Cutting Balloon to 12 Atmospheres



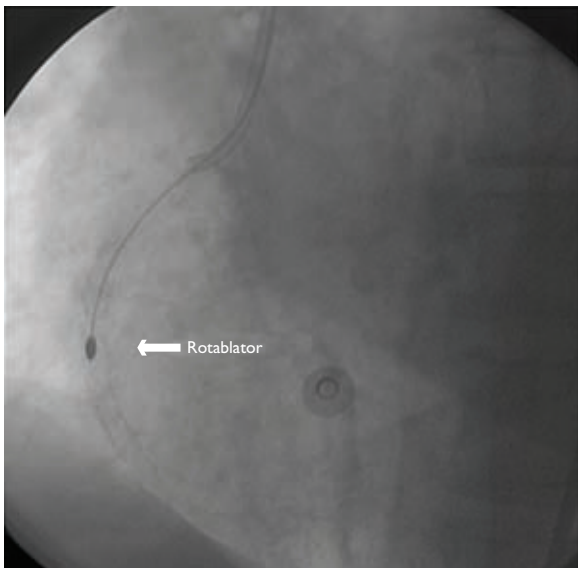
Left anterior oblique view. Note residual waist in the proximal part of the lesion and a complex type D dissection distal to the waist.

Figure 3: Right Coronary Artery After Stenting with a 3.5x38mm Bare-metal Stent Distally and a 4x18mm Bare-metal Stent Proximally (with the Stents Overlapped at the Site of the Residual Waist, Both Deployed at 16 Atmospheres), and Post-dilated with a 4mm Non-compliant Balloon that Ruptured at 25 Atmospheres



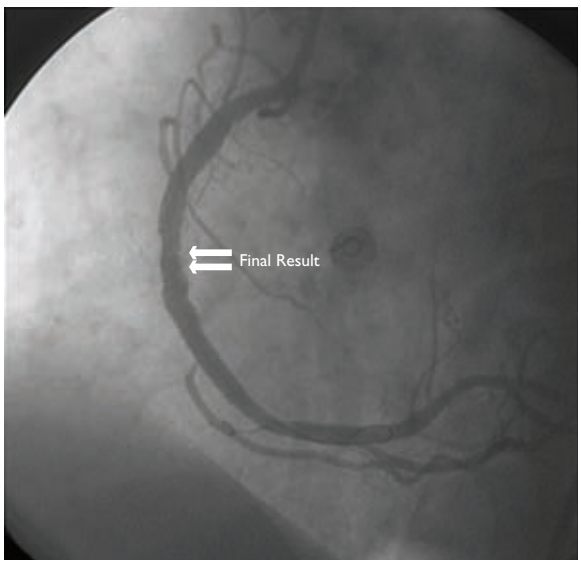
Left anterior oblique view.

Figure 4: Rotational Atherectomy Burr (2mm) in the Right Coronary Artery After Crossing the Lesion



Left anterior oblique view.

Figure 5: Right Coronary Artery After Expansion of the Residual Waist at 20 Atmospheres with a 4mm Non-compliant Balloon



Left anterior oblique view.

was mildly reduced at 50–55%. Serum creatinine was stable after admission, and the patient was discharged in stable condition on the fourth day.

Discussion

The case is notable because rotational atherectomy resulted in procedural success despite the presence of two usual contraindications: thrombotic vessel occlusion and extensive dissection. Treatment of the lesion to remove angiographic evidence of both thrombus and dissection before PRCA was employed may have contributed to the success of the procedure.

Early studies of PRCA cautioned its use in possible thrombus-containing lesions in acute coronary syndromes and acute MI because of possible distal embolization with slow-flow or the no-reflow phenomenon.[4,5] However, subsequent investigators demonstrated that unstable lesions do not represent an absolute contraindication to PCRA. Doshi et al.[1] reported that PRCA in selected acute coronary syndrome lesions resulted in similar incidence of post-procedural myonecrosis and 30-day major adverse cardiac events compared with stable lesions. In the setting of acute ST-segment-elevation MI, Ho et al. successfully used rotational atherectomy to dilate an undilatable lesion.[6] Herzam et al. used rotational atherectomy after stent deployment in an acute MI patient to fully expand a stent with a residual waist.[7]

Coronary dissection has been considered a contraindication to PCRA.[8] However, Pederson et al.[3] reported successful PRCA of a heavily calcified lesion after angioplasty failed to dilate the lesion but produced occlusive coronary dissection.

Use of PRCA to ablate the metal struts of a stent, as was done in our case, has been reported previously. This may be necessary in two situations. The first is to facilitate entry into jailed side branches of stented arteries.[9] In these cases, PCRA can ablate the stents obstructing the side branch and allow passage of bulky equipment such as cutting balloons or stents. The second situation is when stents are deployed in non-dilatable lesions. Ideally, when percutaneous coronary intervention of heavily calcified lesions is undertaken, balloon pre-dilatation is performed to identify non-dilatable lesions. However, occasionally direct stenting without pre-dilatation results in stent deployment in a non-dilatable lesion. Since this may lead to increased risk of acute stent thrombosis or long-term restenosis,[3,7] the operator must balance these risks versus the risk of aggressive strategies such as use of cutting balloons within the stent, high-pressure balloon dilation above rated burst pressures, or PRCA. When PRCA is undertaken in this setting, ablation of the stent struts and underlying calcific or fibrotic tissue at the site of the residual stenosis may result in release of the plaque and successful full stent expansion.[7,10,11] No adverse consequences of this strategy, to our knowledge, have been reported.

When angioplasty identifies a non-dilatable lesion, the operator must decide among various strategies. One is to

proceed directly to PRCA. However, in high-risk lesions such as those containing thrombus or dissection, use of PRCA may risk causing additional complications. In such cases, stenting across the lesion may stabilize it, trapping or dislodging thrombus and sealing any dissection. It is possible that PRCA may be safer after compared with before stenting of a high-risk lesion. While in our case PCRA was used as the strategy of last resort, for non-dilatable lesions a planned strategy of stenting followed by PRCA may be the treatment of choice. ■

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