1026 **Low Contrast Percutaneous Coronary Intervention of Severe Calcified Lesion in Chronic Kidney Disease**

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Case summary:

A 66-year-old man who was diagnosed with type 2 diabetes mellitus in 2015 was admitted via the outpatient clinic for evaluation of progressive weight loss and persistently uncontrolled blood glucose levels. Although no specific records were available, he was found to have undergone percutaneous coronary intervention (PCI) at another hospital in 2015. During evaluation for diabetic complications, a coronary computed tomography (CT) scan was performed to assess for coronary artery disease, which revealed calcified lesions involving all three major coronary vessels with an Agatston coronary artery calcium score (CACS) of 6,334.5. In addition, the patient reported a recent worsening of intermittent chest pain and exertional dyspnea. Based on this clinical history and the findings, transthoracic echocardiography was performed, which demonstrated preserved left ventricular systolic function (LVEF 49.5%) along with regional wall motion abnormalities involving the basal to mid inferior wall, and the basal anterolateral and mid inferolateral segments. Based on the preceding clinical findings, diagnosed with unstable angina, coronary angiography was performed via a right radial approach. The angiogram revealed multivessel coronary artery disease with severe calcified lesion (Figure 1). Specifically, there was a 30% concentric stenosis with heavy calcification in the left main artery, diffuse calcified lesions with up to 85% stenosis in the left anterior descending artery (LAD), and up to 75% in the left circumflex artery (LCx) with up to 60% stenosis at obtuse marginal branch (OM1). The right coronary artery (RCA) showed subtotal occlusion with severe calcification and demonstrated 95% in-stent restenosis at the distal segment. Collateral flow with grade 3 from the distal LAD to the RCA was also noted. Given the presence of diabetes mellitus and complex multivessel disease with severe calcification, surgical revascularization with coronary artery bypass grafting (CABG) was recommended as the initial strategy. However, the patient strongly refused surgical treatment. The final diagnosis was unstable angina with complex three-vessel coronary artery disease. As an alternative, a staged percutaneous coronary intervention (PCI) was planned.

Given the presence of diabetic nephropathy and chronic kidney disease (CKD), with a blood urea nitrogen (BUN) level of 47.1 mg/dL, serum creatinine of 2.5 mg/dL, and estimated glomerular filtration rate (eGFR) of 33.17 mL/min/1.73 ㎡, the interventional strategy was carefully tailored to minimize contrast exposure. Intravascular ultrasound (IVUS) guided PCI and upfront rotational atherectomy (RA) was planned due to the severely calcified lesion in the left anterior descending artery (LAD). To further limit the use of contrast, previously recorded angiographic images were used as procedural references. In consideration of subtotal occlusion in the right coronary artery (RCA) and collateral dependence from the distal LAD, a temporary pacemaker was inserted via the right common femoral vein prior to LAD intervention.

The PCI targeted the severely calcified lesion extending from the proximal to distal segments of the LAD. IVUS imaging demonstrated a 360-degree encircled superficial calcified plaque throughout the proximal to distal LAD, with visible crack at the distal LAD (Figure 2). Upfront rotational atherectomy with a 1.75 mm burr was performed multiple times at the LAD (Figure 3), resulting in crackle formation within the lesion by IVUS. Following this, a 2.75×15 mm Sapphire II non-compliant balloon was advanced smoothly across the p-dLAD lesion without resistance and inflated up to 20 atm for lesion preparation using high-pressure ballooning. Angiographically, 50% residual stenosis was noted. Confirming satisfactory expansion by IVUS, two drug-eluting stents (Firehawk stent 2.75×29 mm at the mid to distal

LAD and 3.5×23 mm at the proximal LAD) were deployed. Final IVUS confirmed good expansion and complete apposition. The angiographic result demonstrated minimal residual stenosis and TIMI 3 flow (Figure 4).

In this high-risk patient with diabetic nephropathy and complex multivessel disease involving severely calcified coronary lesions, the use of an IVUS-guided PCI strategy combined with upfront rotational atherectomy allowed for successful completion of the procedure via the radial approach, with a total contrast volume limited to only 35 mL.

Discussion:

Patients with chronic kidney disease (CKD) undergoing percutaneous coronary intervention (PCI) are at a significantly increased risk of contrast-induced nephropathy (CIN), with an incidence reported as high as 26.6% [1]. In such high-risk populations, strategies aimed at reducing contrast exposure have become essential [2]. In our case, a low contrast strategy was implemented, utilizing intravascular ultrasound (IVUS)-guided PCI in combination with upfront rotational atherectomy (RA). This approach not only helped minimize the total contrast volume but also reduced procedural time both of which are critical in patients with impaired renal function.

A particularly important aspect of this case is that rotational atherectomy was not used provisionally but rather planned upfront. Although previous randomized clinical trials and observational studies have shown no significant difference in major adverse cardiovascular events (MACE) between upfront and provisional RA strategies in patients with severe calcified lesions [3, 4], upfront RA has consistently been associated with significant reductions in both contrast volume and procedural time in many previous studies [5-7]. Based on these findings, we selected an upfront RA approach in this patient to maximize procedural safety.

Another notable feature of this case is that the entire complex procedure?including IVUS-guided PCI and RA for severely calcified, multivessel disease?was successfully performed via the radial approach. While femoral access has traditionally been favored in complex cases, this outcome supports the feasibility and safety of radial access even in technically demanding interventions, with added benefits of reduced vascular complications and improved patient comfort.

In summary, this case highlights that in patients with CKD and complex, severely calcified multivessel disease, a well-planned interventional strategy incorporating upfront RA and IVUS guidance can safely and effectively minimize contrast use and procedural burden. Furthermore, such complex interventions can be reliably performed via the radial approach, broadening the scope of safe, renal-protective PCI in high-risk patients.

Key pictures:

Figure 1. Coronary angiographic findings of the patient with severe calcified multivessel coronary artery disease. (A) Coronary angiography demonstrated 30% concentric stenosis in the left main artery, lesions with up to 85% stenosis in the left anterior descending artery (LAD), and a grade 3 collateral flow from the distal LAD to the right coronary artery (RCA) (B) The left circumflex artery (LCx) exhibited diffuse calcified lesions with up to 75% stenosis, along with up to 60% stenosis at the obtuse marginal branch (OM1). (C) The RCA showed subtotal occlusion in the mid segment with severe calcification, accompanied by 95% in-stent restenosis at previous distal RCA stent lesion.

Figure 2. Intravascular ultrasound (IVUS) findings. (A) At the distal LAD, a visible crack within the circumferential calcified lesion was observed. (B) IVUS imaging revealed a 360-degree encircled superficial calcified lesion from the proximal to mid left anterior descending artery (LAD).

Figure 3. Procedural imaging during rotational atherectomy. Upfront rotational atherectomy was performed at the left anterior descending artery (LAD) using a 1.75 mm burr with multiple passes. A temporary pacemaker lead is also visible in the right ventricular position during the procedure.

Figure 4. Final coronary angiography after percutaneous coronary intervention. Upfront rotational atherectomy

followed by high-pressure ballooning with non-compliant balloon was performed and two drug-eluting stents (Firehawk 2.75×29 mm at the mid to distal LAD and Firehawk 3.5×23 mm at the proximal LAD) were successfully deployed. Final angiography demonstrated minimal residual stenosis and TIMI grade 3 flow.

Key Words:
Rotational Atherectomy, Chronic Kidney Disease, IVUS, Severe Coronary Calcification

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