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Imaging and Case Report

A Complex Percutaneous Coronary Intervention Guided by Optical Coherence Tomography With Heparinized Saline

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An 88-year-old man with atrial fibrillation, ischemic cardiomyopathy status post biventricular implantable cardioverter defibrillator implantation, coronary artery disease status post coronary artery bypass graft placement, insulin-dependent diabetes mellitus, chronic kidney disease stage 3, essential hypertension, and ventricular tachycardia status post ablation presented with worsening shortness of breath and Canadian Cardiovascular Society grade III angina. His coronary anatomy included a known, widely patent left internal mammary artery to left anterior descending artery bypass and prior stenting from the proximal to mid right coronary artery (RCA), ostial to proximal left circumflex (LCx), proximal to mid second obtuse marginal (OM), and ostial to proximal ramus intermedius artery (ramus). He presented to the hospital and was admitted with a non–ST-segment elevation myocardial infarction, with a peak troponin level of 5.530 ng/mL. His baseline creatinine level was 1.8 to 2.2 mg/dL (creatinine clearance, 30-37 mL/min).

An electrocardiogram demonstrated a ventricular-paced rhythm. Transthoracic echocardiography showed a reduced left ventricular ejection fraction of 28%, decreased from 38%, with wall motion abnormalities unchanged from the previous examination involving akinesis of the apex, midapical inferior wall, and midinferolateral wall. He underwent left heart catheterization. On the day of the procedure, his creatinine level was elevated at 2.5 mg/dL (creatinine clearance, 27 mL/min). We performed a low-contrast angiogram study via right radial artery access, which revealed severe multivessel disease with in-stent restenosis (ISR) (Figure 1A, B). After a multidisciplinary discussion with the heart team, we proceeded with the intervention.

A Dragonfly OpStar Imaging Catheter (Abbott) was advanced into the distal RCA, and optical coherence tomography (OCT) imaging was performed with automatic pullback and heparinized saline injections using a 30-mL syringe for high-intensity injections. In this case, OCT allowed measurements of the length of lesions to determine the appropriate stent length. Severe stenosis, 18 mm in length, was found in the distal RCA (Figure 1C). In addition, the proximal to mid RCA was found to have severe ISR, 30 mm in length (Figure 1D).

Subsequently, a biodegradable polymer sirolimus-eluting 3.5-mm × 30-mm stent was deployed in the proximal to mid RCA, postdilated with a noncompliant 3.5-mm balloon at 20 atm. Post–percutaneous coronary intervention (PCI) OCT imaging demonstrated excellent stent expansion and apposition (Figure 1E).

A biodegradable polymer sirolimus-eluting 3.5-mm × 18-mm stent was deployed in the distal RCA, postdilated with a noncompliant 3.5-mm balloon at 20 atm. Post-PCI OCT imaging demonstrated excellent stent expansion and apposition (Figure 1F).

Next, we proceeded with the LCx investigation. A Dragonfly OpStar Imaging Catheter was advanced into the distal LCx. Using heparinized saline injections as flushing media, imaging demonstrated severe ISR in the ostial to proximal LCx and proximal to mid second OM, followed by complete in-stent occlusion distally. Pre-PCI OCT showed neoatherosclerosis with concentric thick calcification (Figure 1G).

Therefore, coronary intravascular lithotripsy was performed with a 3.5-mm × 12-mm Shockwave balloon to the ostial to mid LCx. Next, a 2.5-mm × 22-mm drug-eluting stent was advanced and deployed at the mid to distal first OM, and a 3.0-mm × 40-mm drug-eluting stent was deployed in the proximal to mid LCx with balloon-anchoring support.

Final limited angiography demonstrated mild nonobstructive ostial to proximal ISR in the ramus, followed by severe tandem lesions distally. A 2.5-mm × 35-mm drug-eluting stent was deployed in the mid to distal ramus with balloon-anchoring support.

At the conclusion of the procedure, a total of 10 mL of iodine contrast was administered. OCT was performed during the intervention, with only heparinized saline injections as flushing media. There were no complications of the procedure. Postprocedural renal function remained stable.

Discussion

Optical coherence tomography is an intravascular imaging tool to optimize coronary revascularization; however, it uses light-based technology most commonly requiring iodinated contrast to clear blood for image acquisition.[1] Because of the potential increased contrast use associated with OCT, there is increased risk of renal impairment.

Keywords: complex percutaneous coronary intervention; heparinized saline injections; optical coherence tomography.
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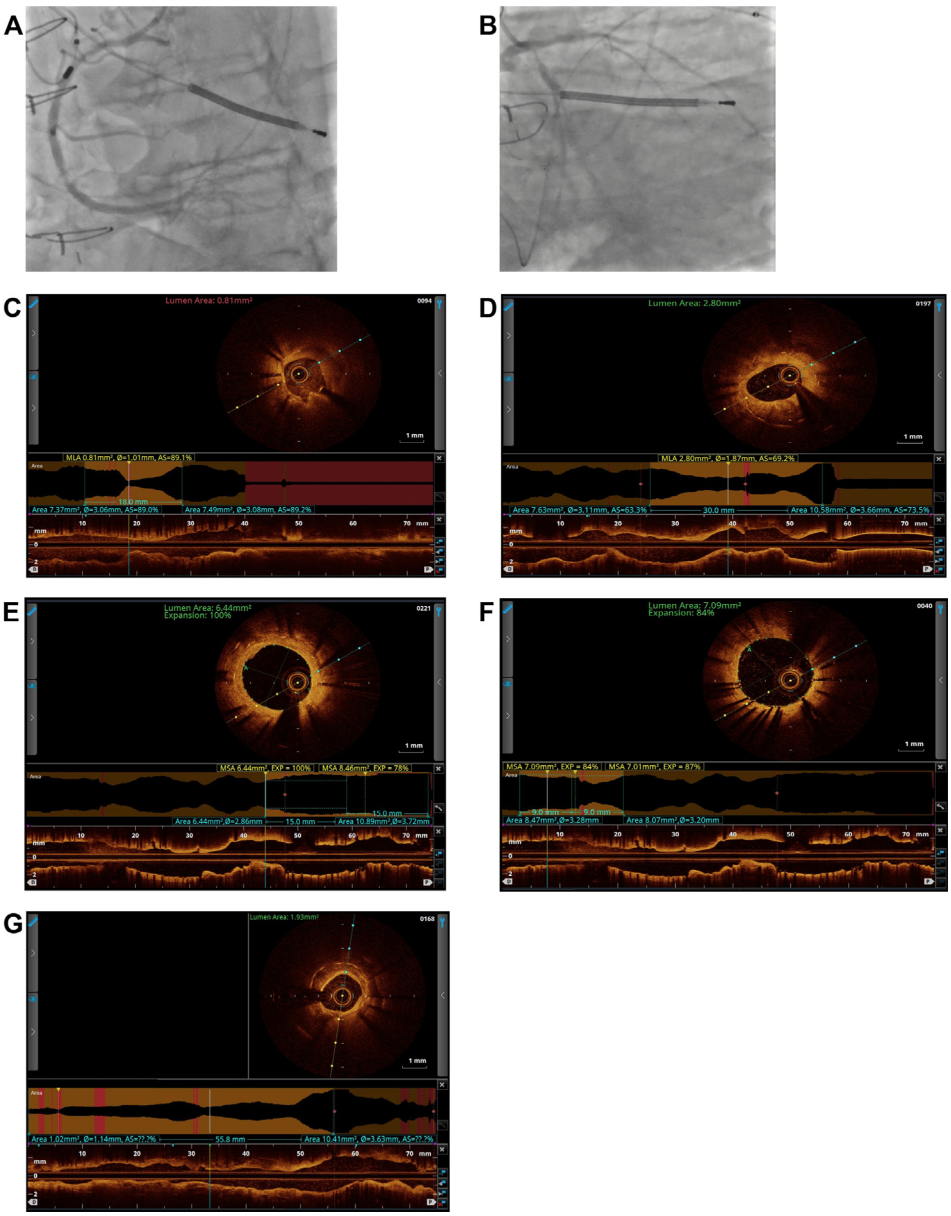

Figure 1.
Optical coherence tomography imaging with heparinized saline injections. (**A, B**) Low-contrast angiograms revealing severe multivessel disease with in-stent restenosis. (**C**) The distal right coronary artery (RCA) exhibited severe stenosis, 18 mm in length, on optical coherence tomography (OCT) imaging. (**D**) Severe in-stent restenosis in the proximal to mid RCA, 30 mm in length. (**E**) Post–percutaneous coronary intervention (PCI) OCT imaging showed 100% expansion of the 3.5-mm × 30-mm stent in the proximal to mid RCA, postdilated with a noncompliant 3.5-mm balloon. (**F**) Post-PCI OCT imaging showed 84% expansion of the 3.5-mm × 18-mm stent in the distal RCA, postdilated with a noncompliant 3.5-mm balloon. (**G**) Pre-PCI OCT imaging showed neoatherosclerosis with circumferential calcification in the ostial to mid left circumflex.

Contrast-induced acute kidney injury (CI-AKI) has a strong correlation with poor long-term cardiac outcomes, including mortality. Unfortunately, there is no treatment for CI-AKI; hence, the focus is on prevention, limiting the total volume of contrast administered during interventions. Efforts to reduce contrast with low-osmolar contrast media has yielded substantial monetary savings to hospitals.[2] In addition, studies have investigated alternative flushing media for OCT, including dextran, carbon dioxide, and saline.[3] Although studies have suggested that saline generates reduced dimensions compared with contrast media, the overall image quality is comparable.[4] In our case, the potential for CI-AKI was of particular concern because of his advanced baseline kidney disease, multiple other comorbidities, and complexity of his multivessel disease. Intravascular ultrasound is the standard technique to guide low- or zero-contrast PCI.[5] However, our case demonstrated that using saline as the flushing medium for OCT provided excellent imaging quality to guide complete revascularization. As such, OCT with saline may be a feasible alternative to intravascular ultrasound in selected cases. Particularly, in our patient with several ISR lesions requiring serial balloon inflations and complex interventions, such as lithotripsy, OCT was key in prestent planning and obtaining optimal results, and saline was successfully used for a low-contrast study while maintaining quality to optimize coronary revascularization.

On follow-up, the patient did not show any evidence of contrast-induced nephropathy, with a subsequent creatinine level of 2.2 mg/dL (creatinine clearance, 30 mL/min).

Conclusion

In this article, we have presented a case in which heparinized saline injections were used during OCT for successful complex PCI optimization. Saline may be used as a contrast-saving alternative, particularly in patients with severe renal insufficiency.

Declaration of competing interest

Dr. Price reports consulting honoraria, speaker's fees, and proctoring fees from Abbott Vascular and Boston Scientific; consulting honoraria from W.L. Gore, Baylis Medical, Biotronik, Biosense Webster, and Shockwave; consulting honoraria and speaker's fees from Medtronic; and equity interest in Indian Wells, Inc. Drs. Shen and Kadakia reported no financial interests.

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Ethics statement and patient consent

The case report has adhered to the relevant ethical guidelines with patient consent.

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