



Optimizing woven coronary artery management by optical coherence tomography: three cases report

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Woven coronary artery (WCA) is a rare and underdiagnosed anomaly characterized by epicardial coronary artery dividing into multiple twisted single channels then anastomosing at distal segment. The malformation is usually believed as a benign condition without traces of thrombosis or dissection flaps, and merely diagnosed incidentally. However, coincidence of WCA with atherosclerosis or tachycardia may incur myocardium ischemia,^[1] and even caused acute coronary syndrome (ACS) or sudden cardiac death (SCD) in reported cases.^[2–4] Since the absence of evidence, the guideline for management of the coronary malformation is still lacking. Notably, as an intravascular image modality with high resolution,^[5] optical coherence tomography (OCT) may shed lights on diagnosis and management of WCA.^[2] Herein, we reported three cases of optimizing WCA management through performing OCT.

Case 1. A 62-year-old male presented with paroxysmal chest discomfort, intermittent dyspnea and edema of lower extremity for 40 days, then admitted in cardiology department of Chinese PLA General Hospital. Since ten years of hypertension and three years of atrial fibrillation were diagnosed by local hospital, he had been taking bisoprolol, amlodipine, losartan potassium and diuretics. The BNP level was 3339 pg/mL, whereas the echocardiography showed the normal left ventricular ejection fraction. Heart failure with preserved ejection fraction caused by hypertension and arrhythmia was initially diagnosed. Considering the multiple risk factors of coronary artery diseases and

likelihood of ischemic cardiomyopathy, subsequent cardiac catheterization was performed. The coronary angiogram (CAG) showed hazy border in proximal left anterior descending coronary artery (LAD), while mild plaques were identified in other two vessels without obvious stenosis (Figures 1A & 1B). OCT was performed in LAD, delineating the multiple twisted channels without traces of thrombosis or dissection flaps (Figures 1C–G). To further evaluate the myocardial blood flow affected by woven segment, Fractional flow reserve were measured and the calculated value was 0.86, suggesting benign condition and good prognosis without necessity of further intervention. Optimum medication were given by adding single antiplatelet agent and statin.

Case 2. A 61-year-old male was also admitted in our coronary care unit because of unstable angina and prior inferior myocardial infarction, despite optimal medical therapy. Previous CAG in local hospital showed segmental stenosis in right coronary artery (RCA); nevertheless, the following percutaneous coronary intervention (PCI) failed. Prior history of hypertension and diabetes mellitus were also recorded. Creatine in blood serum was mild elevated, meanwhile the echocardiography showed regional inferior wall motion abnormality. The subsequent CAG delineated the woven shaped coronary artery in distal RCA followed by a focally severe stenosis, which indicated the culprit lesion (Figure 2A). After performing OCT pullback, we observed multiple twisted conduits with intact intima indicating WCA, concomitant with distal atherosclerotic plaques. Through measuring minimal lumen area compared to reference lumen area, lumen stenosis in distal RCA accounted

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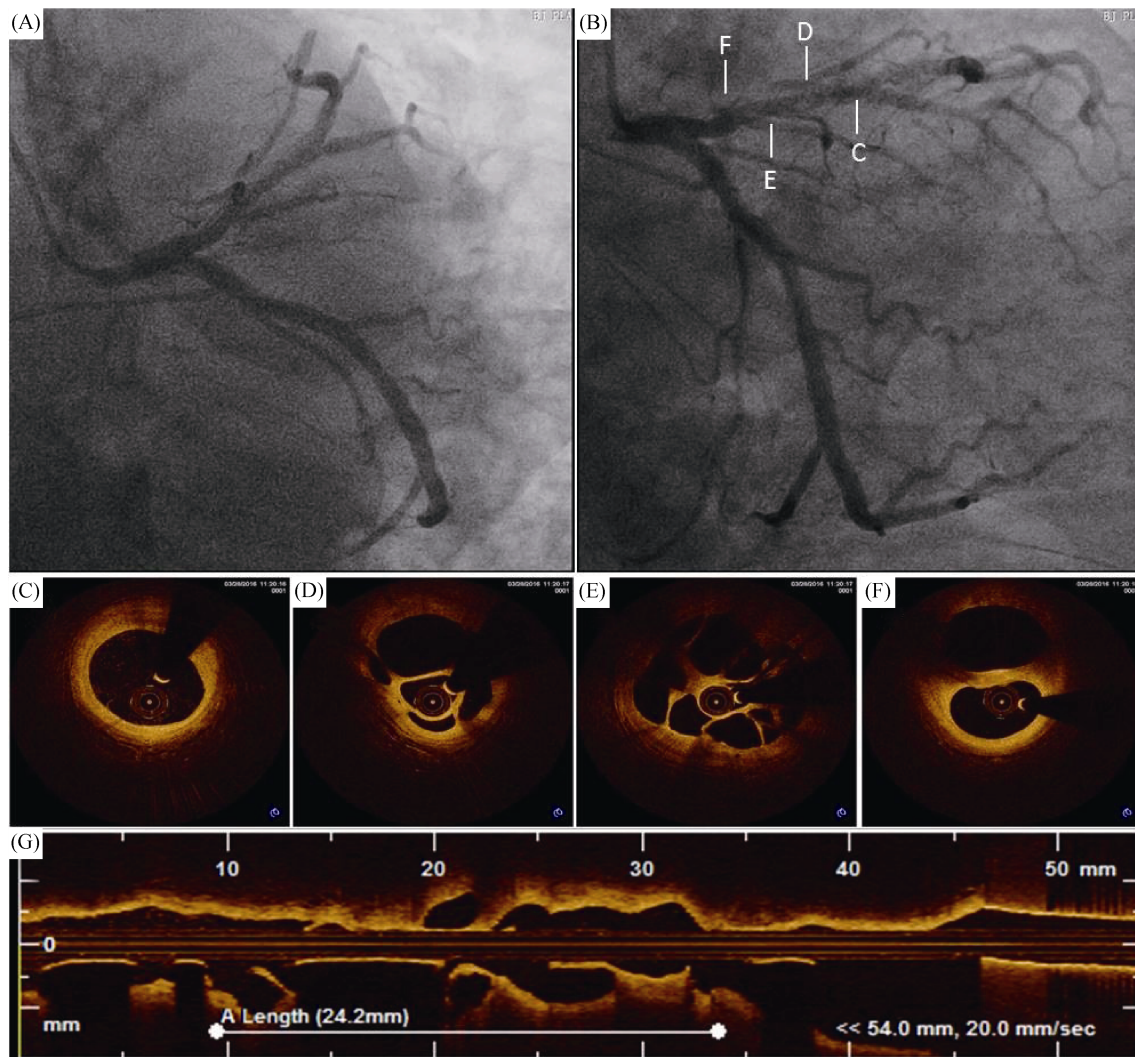


Figure 1. Conservative management of woven coronary artery in LAD. (A & B): Hazy border in proximal LAD; and (C–G): multiple twisted channels without traces of thrombosis or dissection flaps by performing OCT. LAD: left anterior descending; OCT: optical coherence tomography.

for 85% (Figures 2C–E). The PCI strategy is to treat the culprit lesion in distal RCA and revascularize partial WCA simultaneously. After balloon predilations, one 3.5 mm × 23 mm everolimus-eluted stent was deployed, whereas the proximal WCA were not intervened in consideration of its sufficient lumen area. OCT modality was performed again in evaluating apposition of the stent (Figures 2F & 2G). After PCI, the recurrent angina relieved significantly during follow up.

Case 3. A 66-year-old male complaining recurrent chest pain was also admitted in our cardiology ward. He suffered hypertension at 150/110 mmHg without taking medicine, and had long history of heavy smoking. The electrocardiogram delineated inversed T waves on precordial and inferior leads indicating chronic ischemia. Coronary angiography

showed 99% stenosis in proximal LAD, while the woven pattern of proximal RCA followed by segmental 80% stenosis was also identified (Figure 3A). After deploying a drug eluting stent in proximal LAD, we performed OCT to evaluate RCA. Notably, a vulnerable plaque with thin-cap fibroatheroma was identified in company with WCA (Figures 3C–E), suggesting the necessity of intervention. After predilations, two stents at 3.5 mm × 33 mm and 3.5 mm × 35 mm were sequentially implanted at proximal RCA. Another OCT run were acquired in evaluating the stent apposition (Figure 3F). The chest pain was greatly alleviated after the PCI. During the one year follow-up, multislice computed tomography showed stent patency in both LAD and RCA.

As a rare congenital anomaly, WCA was incidentally

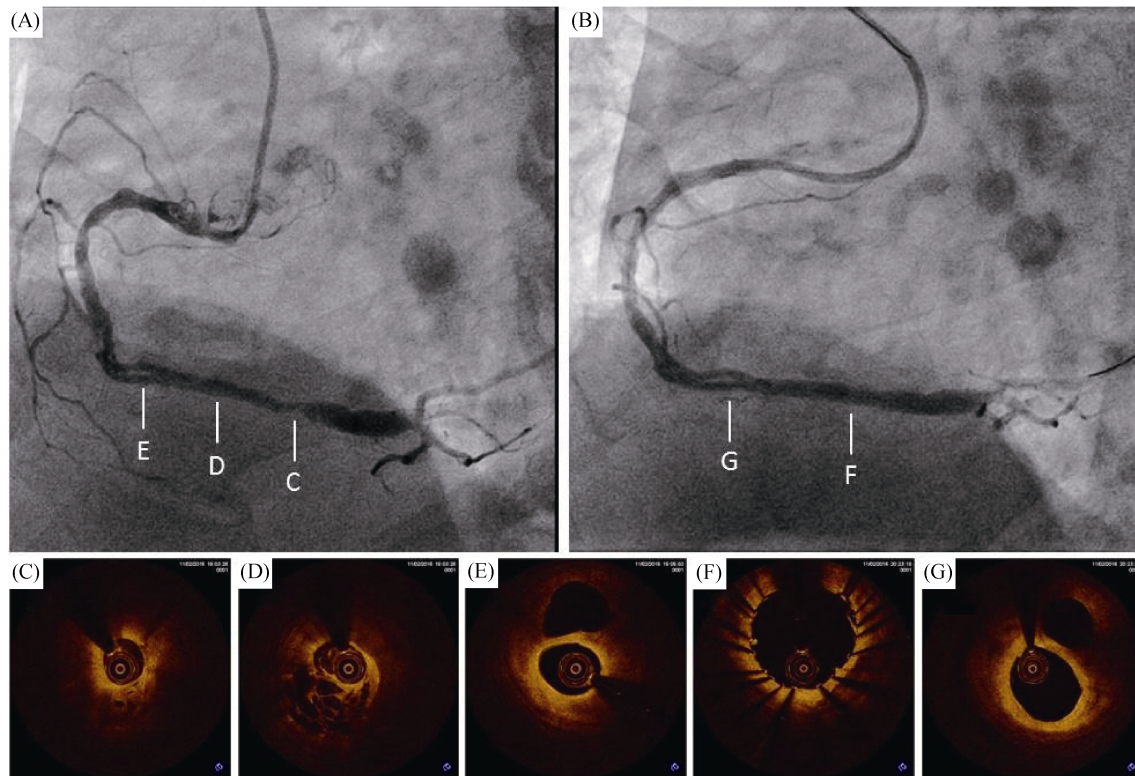


Figure 2. Partial revascularization of woven coronary artery in RCA. (A): Woven shaped coronary artery in remote RCA followed by a severely local stenosis; (B): the angiogram post PCI; (C–E): the severe stenosis and the preceding multiple conduits; and (F & G): distally resolved stenosis and proximally residual WCA. PCI: percutaneous coronary intervention; RCA: right coronary artery; WCA: woven coronary artery.

identified by CAG and reported merely in a few cases.^[1–4] The malformation, usually confined to segmental coronary artery, is characterized by initially dividing into multiple twisted thin channels and then merging the main lumen at the distal point. Accordingly, men are more prone to have WCA than women, while RCA is more susceptible than LAD or circumflex. Occasionally, two or three vessels were simultaneously affected. In our reported cases, three patients were all males; and the affected vessels are two in RCA and one in LAD, respectively. Meanwhile, we found that some WCA appeared in hazy border as our first case CAG presented, which may indicate that the anomaly is easily overlooked and thus underdiagnosed.

Refer to the etiology of WCA, both intravascular high-resolution image and pathological staining showed intact intima without communication among channels and no hints of thrombosis or dissected flaps,^[3] which all supported the speculation that WCA is a congenital malformation rather than repeated spontaneous coronary dissection remodeling or thrombosis organization.^[6] Therefore, WCA, which is mostly incidental finding in CAG of patients with atypical chest discomfort, is generally regarded as a benign

condition with good prognosis, as our case 1 showed. However, in some cases, coinciding with atherosclerotic plaques; the inherently compromised coronary blood flow will deteriorate and may cause ACS or even SCD. In our case 2 and case 3, we clinically inferred that WCA and concurrent atherosclerotic plaque caused recurrent and refractory angina collectively. However, whether congenital WCA, which incurs subtle change in coronary circulation and blood shear stress, eventually results in susceptibility to atherosclerosis, especially at distal segment, is still unknown and needs further study.

OCT, an intravascular image modality with high resolution, is usually called optical biopsy based on high accuracy in recognizing atherosclerotic plaques and guiding revascularization.^[7] In our cases of WCA, not only multiple twisted channels with intact intima were observed by using OCT, but also stenosis severity of the lesions were all measured accordingly. Furthermore, coronary blood flow in the case 1 was evaluated by fractional flow reserve measurement to formulate the following management strategy. Finally, stents expansion and struts apposition were also evaluated by OCT for optimizing interventional therapy.

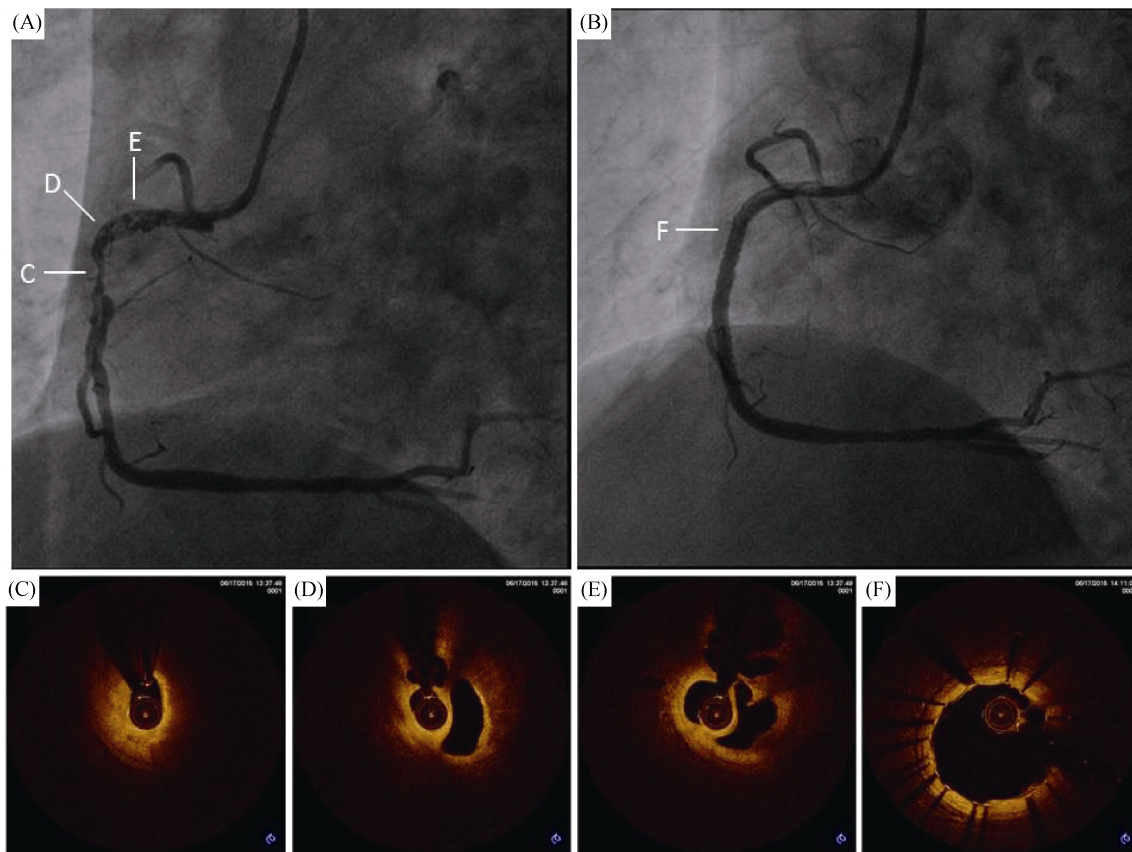


Figure 3. Complete revascularization of woven coronary artery in RCA. (A): Woven shaped coronary artery in proximal RCA followed by a segmental stenosis; (B): the distal stenosis was resolved after two stents implantation; (C–E): the severe stenosis and the preceding multiple conduits; and (F): the apposition of stent struts. RCA: right coronary artery.

In conclusion, WCA is a congenital and underdiagnosed anomaly. Although it is usually regarded as a benign condition, sometimes it may cause ACS or even SCD especially in the case of coinciding with atherosclerotic plaques. OCT was an optimal imaging modality in evaluating WCA severity and optimizing treatment strategy. Moreover, post-PCI evaluation can also be achieved through OCT implementation.

Acknowledgments

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