Multi-Vessel Disease PCI with Concomitant CTO in a Symptomatic Patient: A Case Report

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Abstract

Chronic total occlusion (CTO) is defined as occlusion of the coronary artery with TIMI blood flow 0-1, present for over 3 months. Invasive treatment options for CTO include coronary artery by-pass grafting (CABG) surgery or percutaneous coronary intervention (PCI). In case of multi-vessel coronary disease with concomitant CTO, revascularisation strategy might be challenging. Hereby we present a symptomatic patient with a multi-vessel coronary artery disease who underwent CTO PCI with the retrograde approach after failure of the regular antegrade PCI. Our PCI strategy based on iFR and FFR measurements of non CTO coronary lesions. Functional flow reserve (iFR) measurements of all coronary lesions may support and optimise revascularisation strategy. PCI CTO represents a demanding procedure without proved survival benefits but reduction of clinical symptoms.

Keywords: chronic total occlusion, multi-vessel coronary disease, percutaneous coronary intervention, strategy

Introduction

Chronic total occlusion (CTO) is defined as a complete or nearly complete blockage of a coronary artery, present for over 3 months and responsible for clinically significant blood flow reduction (TIMI 0-1) [1,2]. Patients with CTO have a
various degree of collateralization of the distal vessel, which may be insufficient, resulting in ischemia and angina symptoms, more pronounced on exertion [3,4]. Therapeutic options in patients with CTO include optimization of medical therapy and prevention of underlying disease. Patients who remain symptomatic or have a large burden of ischemia despite optimal medical therapy can be considered for revascularization, either surgical or percutaneous [1,5-9]. In this case, we present a patient who underwent CTO PCI with retrograde approach after anterograde CTO PCI complication.

Case Presentation

A 49-year old Caucasian male presented with a pathological result of treadmill test showing diffuse inferior wall ST segment depression during the recovery phase of a stress test performed up to 9.9 MET with a peak blood pressure of 190/90 mmHg and peak heart rate of 175 beats per minute. Complete regression of the ST elevations was recorded after a 4 minute resting period. The patient was completely asymptomatic during the treadmill test as well as during the recovery phase. Perindopril, aspirin, bisoprolol and atorvastatin were prescribed and coronary angiography was suggested.

The patient reported no previous heart disease, had no difficulties on physical exertion, moreover his daily routine included 30-40 km of bicycle riding. On his last systematic examination mild hepatic steatosis and gastro-oesophageal reflux were diagnosed. He was an active smoker of up to 20 cigarettes per day. He consumed 2 cups of coffee and 2 decilitres of wine daily. No allergies were reported. Patient's family history of heart disease and cancer was negative. Physical examination revealed blood pressure of 130/80 mm Hg, heart rate 93/minute, respiratory rate 15/ minute, oxygen saturation 98% without oxygen supplementation and body temperature 36.6 °C. Clinical examination of the heart, lungs and abdomen showed no pathological findings. ECG demonstrated sinus rhythm with ventricular rate of 93/minute, Q waves in inferior wall leads, incomplete right bundle branch block and negative T wave in lead V6. Transthoracic echocardiography showed left ventricular ejection fraction of 50% with visible hypo-kinesia of the proximal part of the inferior wall, discrete criteria of diastolic dysfunction, preserved right ventricular function, minimal mitral, tricuspid and aortic regurgitation. In conclusion ECHO showed an ischaemic heart with slightly reduced left ventricular systolic function. Invasive cardiologic diagnostics followed. Left ventricular angiography showed normal dimensions of the left ventricle with no regional wall motion abnormalities, left ventricular ejection fraction of 65% and mild mitral regurgitation.

Selective coronary angiography showed no significant stenosis on LMCA and serial stenoses of LAD. Circumflex was sub-totally stenosed after the M2 bifurcation with diffusely narrowed distal part. RCA was completely occluded proximally with the distal part of the vessel filling retrogradely through left-to-right collaterals from LAD septal branches (Figure 1).
IFR of LAD: 0.91, FFR 0.82.

Myocardial nucleotide scan with treadmill test was performed to assess cardiac perfusion and viability. The patient reached 170W – 85% of predicted workload without chest pain. During the test, ECG showed ST segment depressions in the inferior wall leads as well as horizontal ST segment depressions in leads V2 to V6 up to 3 mm. Rare monotopic ventricular extrasystoles were recorded during the resting phase. Myocardium of the left ventricle was estimated as completely viable with fixed perfusion defects in 2 basal segments of the inferior, inferolateral and lateral wall. Extensive reversible perfusion defects were detected in the apical portion of the inferolateral wall as well as in the lateral wall covering 7 of 20 segments (more than 30%) of the left ventricular myocardium. Global left ventricular function was preserved with a slight decrease in ejection fraction on exertion.

Considering the results of the diagnostic tests performed above, the first treatment option was PCI on the chronically occluded RCA with anterograde approach. For visualisation, a bilateral femoral approach was used and Amplatz left 1 6F as a guiding catheter. We tried to pass the occlusion using Rinato (Abbott), Whisper MS and Whisper ES (Asahi) wire with no success. While using Miracle Bros 3g wire with a support of Mini Trek 1,2x8 mm balloon, a dissection and small perforation appeared in the section of the occlusion with a small contrast extravasation from a tiny marginal branch. After a 20-minute period, angiography was repeated and showed no residual or on-going extravasation (Figure 2). TIMI 3 flow was present in the native RCA distal to the occlusion. Due to the complications, the procedure was aborted.

In spite of stenosis of LM and LAD, we decided to attempt revascularization with a retrograde approach a few days later (Figure 3). A bilateral femoral approach was used with Amplatz left 1 6F guide catheter in RCA and Judkins left 4.0 6F in LAD. A retrograde passage of Sion Blue (Asahi) wire through the LAD septal branch into the RCA and through the occlusion was performed with support of Corsair microcatheter (Figure 4). Multiple retrograde dilatations of RCA were performed using Mini Trek 1,2x8 mm, Mini Trek 1,5x8 mm and Kaname 2,0x15 mm. These were followed by retrograde wire externalization into antegrade RCA guide. A prowater wire was passed antegrade into distal RCA. Stenting of the distal RCA with Resolute integrity 2,5x12 mm to 16 atm followed, the RCA vertical segment was stented with Xience Expedition 3,0x12 mm to 16 atm and Xience Expedition LL 3,5x33 to 18 atm which extended to the ostium of RCA. RCA ostium as well as the stent-overlap segments were post-dilated to up to 20 atm. A small dissection appeared in front of the distal stent and was covered with Resolute Integrity 2,75x14 mm to 18 atm. The final result of the procedure was estimated as good with TIMI 3 anterograde flow and no residual stenosis in RCA (Figure 5).

To provide detailed information on coronary arteries, OCT was performed. RCA showed good stent expansion with no residual dissections. iFR anf FFR ob LAD stenosis after CTO PCI were 0.95 and 0.88.
The patient was discharged on the next day. Perindopril, bisoprolol, sorvastatin and aspirin were prescribed as a life-long therapy, prasugrel was added for the duration of 12 months. On his regular follow-up after one month the patient was asymptomatic and had returned to his regular daily activities including all sport activities.

Discussion

Among patients with a clinical indication for coronary angiography the incidence of CTO ranges from 15 to 30% [10,11]. Symptoms and signs in patients with CTO do not differ significantly from those of non-CTO patients with a significant coronary artery disease. The clinical picture can range from asymptomatic to acute onset of symptoms and should not be confused with STEMI or NSTEMI, with special regard to ECG dynamics and time component [4]. In our patient invasive diagnostics revealed a MVD with CTO of RCA with clinical indication for CTO revascularization. The Synergy between Percutaneous Coronary Intervention with Taxus and Cardiac Surgery (SYNTAX) trial showed that there were no major differences in the rate of death and myocardial infarction between patients having a multi-vessel coronary artery disease treated with PCI and those treated with coronary artery by-pass grafting (CABG). The final decision on CABG or PCI remains individual and depending on patient as well as the operator. The main benefits of CTO PCI are reduction of the need for late CABG, improvement of the symptoms and left ventricular function [9, 12].

Modern strategy to select target vessels for revascularisation is the use of functional measurements. In case of CTO with distal collaterals the estimation of stenosis on donor arteries may be challenging. We may expect but not predict the reduction of functional severity of a certain lesion on donor artery after successful PCI of CTO. Therefore, the revascularisation strategy in MVD with concomitant CTO might be challenging. PCI CTO in case of MVD as the first revascularisation step might be a rational strategy; namely in case of failure a complete CABG MVD revascularisation might be an acceptable strategy [1].

The success rate of CTO PCI in pre-stent era was 51% [13], after the introduction of coronary stents it increased to approximately 70-85% [13-15], which is still far below 97% success rate for non-CTO lesions PCI [16]. Additionally the procedure is at least twice as long as a non-CTO PCI, more radiation and more contrast is needed. With a more aggressive approach and concomitant poor or absent visualization, complications occur more often. One of the CTO PCI complications is coronary artery perforation or dissection, which was also the complication in our case. An experienced cardiologic centre in Japan reported in-hospital complication rates of 0.5% for death, 3% for myocardial infarction, 0.2% for emergency CABG, and 0.6% for tamponade [17,18]. These rates probably do not reflect the rates of less experienced centres [19].
With introduction of new technology for coronary artery visualization, intracoronary visualization and measurement technologies, through new wire designs as well as newer approaches to CTO PCI including the retrograde approach described in our case report, the success rate is increasing [1].
Retrograde approach is one of the latest CTO PCI techniques [1,7]. During the procedure, the occlusion site is approached retrogradely through a collateral channel, either epicardial, interatrial, intraseptal or even bypass graft, connecting the two coronary arteries. Starting with a bilateral introduction of guiding catheters through femoral or radial artery, left and right coronary arteries are reached. With the use of various guiding catheters, the occlusion is crossed retrogradely and followed by balloon dilatation for connecting of anterograde and retrograde channels. Due to its complexity it is reserved as a second option of treatment after an unsuccessful anterograde approach.
In our case, advancing the guide wire with anterograde approach failed and dissection occurred as a complication. Therefore, we decided for a retrograde approach using left-to-right collaterals of septal LAD branches to access the occlusion on RCA. This time, the passing of the guide wire was successful and was followed by dilatation and stenting of the occluded vessel.

Consent

1. In our cat lab the indication for CTO PCI are: exertional angina, nucleotide scan proved viability as well as ischemia of more than 10% of LV myocardium.
2. The decision for CTO PCI is driven by the lesion complexity and operator skills.
3. Bilateral coronary injection is a mandatory PCI CTO strategy.
4. In case of a retrograde CTO PCI the PCI strategy should be flexible, starting with a simple one and proceeding to complex one.
5. We should prepare a bailout strategy for the case of predictable complications.

Our case showed the importance of MVD evaluation with iFR and FFR. In case of CTO the values obtained on donor vessel should be evaluated with caution. We should be aware that the values are flow driven. As was shown in our case borderline values before PCI showed normal coronary flow reserve after CTO PCI.
Our strategy of PCI RCA in later re-evaluation of donor artery flow was proved to be correct. Our strategy bear also reserve scenario with donor vessel PCI in case of clinical and functional indication. The positive result of PCI CTO reduced PCI strategy from two to only single vessel treatment.
Clinical data support CTO PCI as a symptomatic treatment. It may bear better survival rate just in the case of CTO PCI being a part of complete coronary revascularisation [5,9,12].
In our case we used strategy of the first antegrade CTO PCI, after failure we shifted to retrograde one. OCT proved optimal stents expansion which might be important especially in case of long lesion stenting. DAPT with aspirin and clopidogrel was introduced.

References


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Figures:

Fig.1 Coronary angiography. Note occlusion of RCA with R-L septal collaterals (Rantop 2).
Fig. 2 Antegrade PCI of RCA. Note both a dissection and perforation at occlusion site.

Fig. 3 PCI CTO RCA: 2nd attempt. Antegrade wire in false lumen. Septal collateral suitable for retrograde approach is clearly presented.
Fig. 4 PCI CTO RCA. Retrograde wire externalisation through septal brach and RCA occlusion into RCA guiding catheter. Retrograd balloon dilatation and antegrade escalation of wire for final PCI with stenting.
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Fig.5 final result after PCI RCA.

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