INTRODUCTION

Chronic total occlusion (CTO) of a coronary artery accounts for 15% of cases during diagnostic angiography.\(^1\) Percutaneous coronary intervention (PCI) for CTO was used to be one of the most challenging fields in the interventional cardiology in the past decade. However, PCI for CTO has dramatically improved recently because of the various technological advancements and increasing experiences. As a result, successful PCI for CTO has shown clinically meaningful benefits like symptom reduction and improvement in heart function and survival.\(^2,3\)

In particular, retrograde approach through collateral channels, initially developed in Japan and advanced throughout the world,\(^4,5\) has provided incremental procedural success rate. However, retrograde approach from the opposite coronary artery is not always applicable. In certain left anterior descending coronary artery (LAD) CTO cases, the distal LAD is supplied from the intraseptal (proximal to distal septal) collateral channels.

Here, we present a case of the retrograde PCI for the CTO at LAD via an ipsilateral intraseptal collateral channel, which was successfully revascularized with reverse CART technique, using a single 8-French guiding catheter.

CASE REPORT

A 58-year gentleman presented with typical effort-related chest pain (CCS III) and abnormal coronary CT angiogram (LAD CTO and right coronary artery CTO). His coronary risk factors were previous myocardial infarction which was medically treated 3 years ago, diabetes, dyslipidemia, and smoking. The physical examination was unremarkable. The initial electrocardiogram showed pathologic Q-wave in the inferior leads, and cardiac enzymes were normal. The transthoracic echocardiography showed near normal LV systolic function (EF=48%) with akinesia of the inferior wall. LAD CTO lesion was judged as a main culprit lesion (Figure 1) and PCI for the LAD CTO lesion was planned considering the perioperative risk of coronary artery bypass graft.

First, transradial antegrade approach was tried. The wire penetrated the proximal CTO cap but the floppy or dedicated stiffer guide wire could not reach the distal true lumen (Figure 2a). A parallel wire technique using Miracle 3g (Asahi Intecc, Nagoya, Japan) and Fielder XT (Asahi Intec, Seto, Japan) was also failed, because of several unfavourable characteristics of CTO anatomy such as severe calcified, stumpless occluded segment and severe tortuosity proximal to occluded segment (Figure 2b).

At this point, antegrade approach was stopped and accessible collateral channels were searched for the retrograde approach. After a careful review of the diagnostic coronary angiogram, which showed that the distal LAD CTO was filled from the proximal septal...
branch connected to the distal septal branch (Figure 2c), intraseptal collateral channels were selected for ipsilateral retrograde route and intubated an 8-French Judkin’s left (JL) 4 guiding catheter (Cordis, Miami, Fla., USA) to the left main from the femoral artery. On further confirmation of intraseptal collateral by superselective septal channel angiogram, the corkscrew tortuosity of septal collateral channel was successfully negotiated, preceded the distal septal branch and reached the distal entrance of the CTO using Sion (Asahi Intecc, Aichi, Japan) and Fielder FC (Asahi Intecc, Seto, Japan) guidewire alternatively with a Finecross microcatheter (Terumo, Tokyo, Japan) (Figure 2 d,e). However, direct retrograde guidewire passage using floppy and stiffer dedicate wires failed because distal CTO cap was also hard. Next reverse subintimal dissection re-entry technique, controlled antegrade and retrograde tracking (CART), was used with conquest pro (Asahi Intecc, Japan) and crossed the proximal true lumen (Figure 2f). The microcatheter was advanced to p-LAD with anchoring balloon. After externalization of the changed guidewire (Fileder FC 300) (Asahi Intecc, Seto, Japan), a 2.5 mm balloon was introduced from the antegrade and expanded the CTO lesion. Then the wire was confirmed in true lumen by intravascular ultrasonography (IVUS). After IVUS study, stent was deployed at proximal LAD via externalized wire (Figure 2g). Securing the antegrade flow, the new antegrade wire Sion (Asahi Intecc, Aichi, Japan) was introduced to the distal LAD and entire retrograde system was removed (Figure 2h). After repetitive angiogram and IVUS study, two more stents were deployed at distal LAD (Xience Prime 2.5 x 38 mm and 2.5 x 15 mm) (Abbott, Abbott park, IL, U.S.A). On final angiogram, there was no procedural-related complication such as dissection or rupture (Figure 2i). The patient had no adverse events and has been stable on one year follow-up.

**DISCUSSION**

With the recent advancement, the success rate of CTO PCI has increased to about 85% with favourable characteristics. The CTO lesion in this case had several unfavourable characteristics such as severe calcified, stumpless occluded segment, and severe tortuosity proximal to occluded segment. So, antegrade guidewire passage failed as expected. Retrograde approach was used because the distal cap is more amendable to penetration than the proximal cap as the CTO lesion is suggestive of thinner and softer distal fibrous cap histologically.

Selection of a suitable collateral channel is the key to successful retrograde approach. Practically, there are several collateral channels used for retrograde approach. Those are septal connections which are the most preferred and the safest route, epicardial...
connections, cornus branch connections, diagonal collateral channels and distal interarterial connections. Among these, septal collateral channels are the safer and most widely preferred route. However, cases of retrograde procedure via intraseptal collateral channels are rare because it has acute angle and corkscrew tortuosity. In this case, septal collateral channels were not visible because the RCA lesion was also causing CTO. Therefore, the most feasible route for retrograde approach was intraseptal collateral channel despite the limitation. Fortunately, the angle and the tortuosity was negotiated with soft wire with microcatheter to reach the distal cap of the CTO lesion.

Among the different wire-crossing techniques such as kissing wire technique or CART in the retrograde approach for CTO, the reverse CART technique is safe and feasible with a high success rate when used by experienced operator. In this case, the retrograde wire successfully crossed the proximal true lumen supported by antegrade balloon inflation in the subintimal space. During the procedure, we used 8-Fr single guiding catheter because double guiding catheter technique required a second arterial access and the 8-Fr guiding catheter could support the procedure owing to strong backup support and enough inner lumen diameter.

Although the overall complication rate appears to be similar for CTO intervention versus non-CTO intervention, there are unique complications related to retrograde CTO PCI such as dissection or perforation of the collateral channel which can be life-threatening and global ischemia by the simultaneous interruption of blood supply to the target vessel and donor vessel. So, wire passage or procedure at the collateral channel is protected by microcatheter and the microcatheter should be over the collateral channel during the distal cap penetration. When stenting needs to be performed at the initiation site of ipsilateral collateral, the retrograde wire should be removed to avoid entrapment. Fortunately, in this case the stent could be deployed by retrograde because the stenting site was far from the initiation site.

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REFERENCES