Successful occluding by absorbable sutures for epicardial collateral branch perforation

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In order to improve the success rate of chronic total occlusion (CTO) percutaneous coronary intervention (PCI), retrograde approach has been attracted more attention. Recent study reported the collateral perforation rate was 6.9% in retrograde CTO PCI. Collateral related perforations were higher in patients with the epicardial collateral than that with the septal collateral. Several techniques have been developed to deal with the collateral branch perforation. Here, we described the treatment of epicardial collateral branch perforation by absorbable suture segments embolization through microcatheter during retrograde CTO PCI.

A 51-year-old male patient has a chief complaint with typical pectoris angina during exertion for 4 months. Electrocardiogram (ECG) showed sinus rhythm and pathological Q waves on II, III and aVF leads. Echocardiography showed left ventricular end diastolic dimension (LVEDd) was 56 mm, segmental wall motion weakened (posterior wall, lateral wall, right ventricle) and ejection fraction (EF) was 44%. Coronary angiography showed diffuse stenosis about 50% in the middle left anterior descending artery (LAD) with anterior flow TIMI3 grade and the left septal branch to the right collateral circulation (Figure 1A). Coronary angiography showed CTO at proximal left circumflex (LCX) with retrograde flow from ipsilateral branch and atrial branch to the right collateral circulation (Figure 1B). There was CTO at proximal right coronary artery (RCA). Coronary angiography showed no obvious stump and a small branch issued at occlusion site. Ipsilateral epicardial branches from proximal to distal RCA were seen (Figure 1C).

The first PCI process: A 7F femoral artery access and a 7F radial artery access were performed.7F BL 3.5 with side hole guide catheter (Terumo, Japan) was inserted into the left coronary artery (LCA) ostium and Finecross microcatheter (Terumo, Japan) advanced the proximal LCX. Gaia1 guidewire (Asahi, Japan) passed the occlusion site to the true lumen of the distal LCX. Finecross microcatheter advanced to distal LCX, Runthrough NS guidewire (Terumo, Japan) exchanged to the distal LCX and the microcatheter was withdrawn. A Sprinter 2.0 × 15 mm balloon (Medtronic, USA) predilated at 12 atm, Xience Xpedition 3.0 × 33 mm and Xience Xpedition 3.0 × 38 mm (Abbott, USA) stents were implanted and deployed at 16 atm. Angiography showed blood flow with TIMI 3 grade without stent residual stenosis in LCX (Figure 1D).

The second PCI process: 7F AL 0.75 with side hole guide catheter (Cordis, USA) was inserted into the LCA ostium through the right femoral artery approach. The Gaia2 guidewire (Asahi, Japan), with Finecross microcatheter backup (Terumo, Japan), failed to pass the occlusion segment to the intimal space of the RCA. Therefore, we decided to perform retrograde approach PCI via epicardial collateral branch. Runthrough NS guidewire (Terumo, Japan) was sent to the atrial branch, the Ryujin 1.5 × 15 mm balloon (Terumo, Japan) dilated stent mesh, then Corsair microcatheter (Asahi, Japan) successfully passed through the distal collateral channel. The sion guidewire (Asahi, Japan) was exchanged to deliver the distal RCA true lumen via the epicardial collateral channel. The Corsair microcatheter (Asahi, Japan) was sent to the RCA distal for replacement of the Pilot 150 guidewire (Abbott, USA), but could not cross the proximal occlusion site. Conquest Pro guidewire (Asahi, Japan) was advanced to proximal from antegrade, but failed to cross the mid RCA. Then a Ryujin 2.0 × 15 mm balloon assisted with Guidezilla extension catheter (Boston, USA) performed contemporary reverse controlled antegrade and retrograde subintimal tracking (CART) (Figure 2A). Retrograde Pilot 150 guidewire was...
Figure 1. Coronary angiography results. (A): Coronary angiography showed diffuse stenosis about 50% in the middle LAD and the left spetal branch to the right collateral circulation; (B): coronary angiography showed CTO at proximal LCX with retrograde flow from ipsilateral branch and atrial branch to the right collateral circulation; (C): coronary angiography showed CTO at proximal RCA no obvious stump and a small branch issued at occlusion site. Ipsilateral epicardial branches from proximal to distal RCA were seen; and (D): coronary angiography showed blood flow with TIMI 3 grade in LCX and no stent residual stenosis. CTO: chronic total occlusion; LAD: left anterior descending; LCX: left circumflex; RCA: right coronary artery; TIMI: thrombolysis in myocardial infarction.

Figure 2. PCI procedure. (A): A 2.0 × 15 mm balloon assisted with Guidezilla extension catheter performed contemporary reverse CART; (B): a 2.0 × 15 mm balloon predilated at proximal RCA; (C): Coronary angiography showed myocardial contrast staining at atrial branch (circle); (D-F): the reverse Corsair microcatheter was switched to the Finecross microcatheter (arrow) to the proximal epicardial channel and antegrade catheter was exchanged to Finecross microcatheter (arrow). 3-0 absorbable sutures (about 0.8mm in length) were prepared and placed vertically into the tail of the microcatheter and were then slowly pushed into the perforation site using Runthrough guidewire; (G): the perforation of epicardial collateral channel was occluded successfully; and (H): the RCA angiography showed no residual stenosis after stent expansion and with TIMI3 grade blood flow. CART: controlled antegrade and retrograde subintimal tracking; RCA: right coronary artery; TIMI: thrombolysis in myocardial infarction.

advanced to antegrade Guidezilla catheter then to the antegrade SAL 0.75 guide catheter successfully. RG3 guidewire (Asahi, Japan) was switched to externalize and a Ryuji 2.0 × 15 mm balloon through the RG3 guidewire to proximal and distal RCA to predilate (Figure 2B). After dialation, KANEKA double lumen microcatheter (KANEKA co., Japan) with sion guidewire through the RG3 guidewire was sent to distal RCA and sion guidewire was adjusted to post descending artery. Withdrawn the retrograde Corsair microcatheter to LCX, coronary angiography showed myocar-
dial contrast staining at atrial branch (Figure 2C). The reverse Corsair microcatheter was switched to the Finecross microcatheter to the proximal epicardial channel and ante-grade catheter was exchanged to Finecross microcatheter. The RG3 guidewire was withdrawn, a piece of 3-0 absorbable sutures (about 0.8 mm in length) were prepared and placed vertically into the tail of the microcatheter and were then slowly pushed into the perforation site using Run-through guidewires through the bilateral Finecross microcatheters (Figures 2D and 2F). The perforation of epicardial collateral channel was occluded successfully (Figure 2G). A Run-through guidewire was exchanged to distal RCA and Finecross microcatheter was withdrawn. Then Synergy 2.75 × 38 mm (Boston, USA), Xience XP 3.0 × 38 mm (Abbott, USA), and Firehawk 3.5 × 38 mm (Micropoint, China) stents were implanted and released at 14 atm from distal to proximal RCA. The RCA re-angiography showed no residual stenosis after stent expansion and with TIMI3 grade blood flow (Figure 2H).

The retrograde approach usually required guidewire passage via the tiny collateral channels that can increase the perforation incidence. Recent meta-analysis showed there was a higher rate of collateral perforation in retrograde CTO PCI.[1] Although epicardial collaterals in experienced hands may also represent an efficient option, their use is associated with a higher risk of collateral perforation.[4] Epicardial channel perforation is a potentially catastrophic complication of retrograde CTO PCI, as it can result in rapid tamponade, especially in patients without prior coronary artery bypass graft surgery.[5] Sometimes even if looks very minor, it should be dealt with, as it can result in delayed tamponade. For this patient, antegrade approach PCI failed, then transferred to retrograde approach. The epicardial collateral channel was used for retrograde PCI. After CTO lesion recanalization, angiogram showed leakage of contrast material from the epicardial collateral channel.

Collateral vessel perforation is usually treated with several methods, but they all have some limitations and deficiency[5,6]: (1) reversal of anticoagulation might result in self-sealing of the perforation, but could also result in catheter thrombus formation and distal embolization; (2) application of negative suction through the microcatheter may be another effective treatment, which can result in collapse of the vessel wall and transient cessation of bleeding; (3) various materials have been suggested for occlusion, including metal coils, thrombin, autologous blood clot, collagen or subcutaneous tissues.[3,4] However, metal coils implantation requires insertion of a large microcatheter and the cost of metal coils is higher, while autologous clots and collagen can migrate; (4) balloon inflation within the collateral vessel should be avoided in small collateral vessel as they may cause perforation; and (5) we previously described a method for sealing distal CAP by silk suture,[2] but it may lead to silk inlaid when microcatheter passing through the tortuous collateral channel. Here, we described its modified use for the epicardial collateral channel perforation for the first time. We used the Finecross microcatheters of antegrade and retrograde to deliver the absorbable sutures segments for occlusion the perforation successfully.

From this technique, we concluded some steps: (1) it is very important to accurately identify channel perforation. Before and after withdrawal of the reverse microcatheter, nonselective angiography should be performed to check whether the collateral rupture; (2) if there is collateral channel perforation, Finecross microcatheters from antegrade and retrograde should be advanced to the near perforation site through RG3 swiftly. Then bilateral absorbable sutures segments embolization were needed. For the source of bleeding can be from the dural arteries (main or contra-lateral arteries),[2] and (3) the inner diameter of the Finecross microcatheter is 0.4572 mm (0.018 inches), and the cavities are coated with polytetrafluoroethylene that is suit for delivering the 3-0 absorbable sutures segments (with the outer diameter 0.2–0.249 mm) through the epicardial channel.

In conclusion, we describe the successful treatment of collateral channel perforations using 3-0 absorbable sutures segments through Finecross microcatheters from antegrade and retrograde in retrograde CTO PCI. This method has some advantages for low cost, short preparation time, no immune response, easily operation and high success rate. It provides a novel method for the treatment of small distal coronary artery and tortuous epicardial collateral perforation. It appears to be more safe and effective.

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