Bilateral Percutaneous Ulnar Artery Approach for Retrograde Chronic Total Occlusion Intervention

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SUMMARY

The transradial approach for coronary diagnostic and therapeutic interventions is a well-established, safe, and effective technique that has shown a success rate comparable to that of the transfemoral approach for chronic total occlusion (CTO) with less access site complications. Recently, the transulnar approach was also found to be a safe and feasible alternative for diagnostic and percutaneous coronary intervention (PCI). There is limited data on the efficacy and safety of the transulnar approach for CTO PCI. Here, we report the case of a patient who underwent coronary intervention for CTO via the bilateral ulnar approach. (Int Heart J 2010; 51: 137-140)

Key words: Ulnar, Chronic total occlusion, Retrograde intervention

Transradial coronary intervention (TRI) has become a worldwide popular approach, with increasing data showing its safety and efficacy are comparable to those of standard transfemoral intervention (TFI). The advantages of TRI include relatively lower access site complications, early mobilization, and hence shortening of hospital stay.1 With the advancement of miniaturized percutaneous coronary intervention (PCI) devices, forearm vascular access, and operator experience, TRI is also now being used for more complex lesions.

Chronic total occlusion (CTO) occurs in approximately 30-50% of all patients with significant coronary stenosis who have undergone coronary angiography.2 In a recent study, TRI was found to be comparable to TFI with respect to in-hospital major adverse cardiac events (MACE).3 However, radial artery (RA) access still has certain limitations such as the relatively smaller vessel size, higher incidence of vasospasm, and presence of some anatomical variations of RA (eg, radial loop, RA access originating from high brachial or axillary arteries). In such patients, the transulnar (TU) approach may provide a reasonable alternative, but TU had not received much attention until it was reported in 2001.4 The TU approach was then compared to the transradial (TR) approach, which was found to be a safe and effective alternative with a high success rate and low access site complications.5 In our literature search, we could not find any reports on TU for CTO intervention. Here, we report the case of a patient who underwent the bilateral TU retrograde approach for long CTO at the distal right coronary artery (RCA).

CASE REPORT

A 71-year-old man with a history of diabetes, hypertension, and hyperlipidemia presented with stable angina on regular medication. He was admitted for elective PCI for a totally occluded RCA. History of PCI included Taxus Liberte stenting (Taxus Liberte Coronary Stent System; Boston Scientific Corp., Valencia, USA) for the left anterior descending (LAD) artery via a left TR approach in April 2008. His physical examination revealed hypertension (BP 150/80 mmHg), other physical examination findings were unremarkable. Bilateral RA weak pulse was found before PCI, with the presence of a stronger pulse on both ulnar

Figure 1. Photograph showing both forearms with the sheath introducers inserted at both ulnar arteries (Note: the higher approach of the right sheath).
arteries (UA). Optimal size of UA was confirmed by duplex scanning. Electrocardiography (ECG) showed incomplete right bundle branch block with nonspecific ST-T wave pattern changes. Hence, we performed PCI for RCA CTO using a bilateral TU access on July 3, 2009.

The arm was prepared like for a standard TRI approach, and puncture of the anterior wall of the right and left ulnar arteries was made with a 20G single needle. The access site was approximately 6 cm and 3 cm proximal to the pisiform bone. Subsequently, a 0.025-inch hydrophilic wire was advanced; a short 7F introducer sheath and a 6F (10 cm) introducer sheath (Introducer kit; Terumo Corporation, Tokyo) were inserted in the right and left ulnar arteries, respectively (Figure 1). A solution containing 5,000 IU of heparin and 200 μg of nitroglycerin was injected through the 7F introducer sheath. The time for sheath insertion was approximately 5 minutes. Via the sheath with a contrast injection, both radial arteries were patent, but relatively smaller in diameter (Figure 2). Coronary angiography was performed using a 6 Fr Ikari-left 3.5 guiding catheter (Terumo Corporation). RCA revealed long CTO from mid to distal with collateral outflow from LAD via septal branches (Figure 3). The prior three Taxus Liberte stents at the proximal, mid, and distal LAD were patent without significant in-stent restenosis. Focal 75% stenosis was found at the proximal LAD stent edge, which was treated with another drug-eluting stent (DES) (Promus 3.0×15 mm, Boston Scientific Corp.) at 16 atm.

A conventional antegrade approach via a 6 Fr Ikari guide for the RCA CTO was performed with a Finecross microcatheter and a Miracle-3g wire, but was unsuccessful. Subsequently, we shifted to the retrograde approach using a 7Fr BL 3.5x85 cm guiding catheter (Terumo Corporation). Retrograde septal wiring was performed via the LAD with a Fielder-FC wire (Asahi Intecc Co. Ltd., Osaka, Japan) and a Finecross microcatheter (Terumo Corporation). A super-selective contrast injection was administered to visualize the appropriate size and course of the selected collateral branch via the Finecross microcatheter. After the Fielder FC wire was advanced to the posterior descending artery (PDA), sequential low-pressure dilatation of the septal channel was performed with a 1.25x10 mm Ryuji-plus balloon (Terumo Corporation). The Ryuji-plus balloon was advanced to the proximal PDA, and then the Fielder FC wire was changed to a Miracle-3g. Finally the Miracle-6g wire was able to puncture the distal CTO cap with support of an anchoring balloon Ryuji-plus 1.25x10 mm at 10 atm, but it entered into the subintimal space at the mid-RCA CTO segment. Another Miracle-6g guidewire was advanced antegradely, which successfully punctured the proximal CTO cap and passed subintimally into the mid-CTO segment. Controlled antegrade & retrograde subintimal tracking (CART) was performed, and a Maverick 2.0x20 mm balloon was inserted via the retrograde route into the subintimal space and inflated to 12 atm. We were able to redirect the antegrade wire to the distal RCA true lumen, which was confirmed by

Figure 2. Cine frame at the forearm from the selective angiogram of (A) Right ulnar artery, (B) Left ulnar artery demonstrating a relatively larger size than radial arteries.

Figure 3. (A) Right coronary angiogram showing a long chronic total occlusion from mid to distal right coronary artery. (B) Left coronary angiogram showing LAD that previously received 3 taxus stents without significant in-stent segment stenosis; proximal LAD stent showed distal stent edge 75% stenosis. (C) Proximal LAD treated with drug-eluting stent Promus (Boston Scientific) (arrow), well developed tortuous septal collaterals connecting to posterior descending artery (arrow).
contra lateral injection. Sequential balloon dilatation of the CTO lesion was performed via the antegrade route (Figure 4). Intravascular ultrasound (IVUS) confirmed that the wiring course was in the true lumen.

After predilatation of the RCA CTO segment using an NC (noncompliant) balloon Sprinter 3.5×12 mm at 16-18 atm, three Taxus-Liberte stents (3.5x32, 3.5x32, and 4x28 mm) were deployed from the distal to proximal RCA segment. The in-stent portion was redilated with the NC balloon at 20-26 atm. Finally, TIMI-3 flow was achieved (Figure 3B). IVUS study confirmed proper stent expansion and apposition.

Immediately after the procedure, the introducer sheath was removed, and haemostasis was performed using compressive dressing for 4 hours. The total procedure time, total radiation time, and total contrast volume were 260 minutes, 60 minutes, and 300 mL, respectively. The patient was discharged 2 days later without any other hospital events. One month later, Duplex examination of both ulnar arteries revealed inner diameters of 2.5 and 2.7 mm and peak systolic velocity of 83 and 67 cm/sec for right and left ulnar artery, respectively.

**Discussion**

We demonstrated the possibility of using the bilateral ulnar artery approach for PCI of a CTO lesion via the retrograde approach. To the best of our knowledge, a technique involving a bilateral ulnar approach has never been reported. We safely performed the PCI procedure with a radiation time quite comparable to the bilateral radial and femoral approaches described in the study of Hsu, et al.8 In the presented case report, both ulnar arteries were selected for access due to a smaller radial artery from pre-PCI physical examination, which was confirmed by peripheral hand injection through the arterial sheath. In our center, we predominately use “the arm approach”; 91.6% underwent PCI using a transradial approach, 3.5% through a brachial approach, 0.9% a transulnar approach, while the rest underwent a femoral approach.7 Most of the operators were quite familiar with the TR approach for CTO lesions. There were no postprocedural access site problems or ischemic complications up to 1 month. Follow-up Doppler examination also confirmed the patency of both ulnar arteries. Even though occlusion of the ulnar artery may occur after the TU PCI procedure, this event is rare. Our findings showed that using the TU approach in the presence of an atrophied radial artery is safe and feasible. This could be explained by the dual blood supply in the hand and the presence of extensively recruited collaterals, even without evaluation of deep palmar arch integrity by the inverse Allen’s test as reported by De Andrade.9 A similar case report of ulnar artery catheterization in an occluded radial artery has been reported by Lanspa.9

Femoral access for CTO intervention is recommended for most operators, with the use of 7-8 Fr guides to provide better passive support. The feasibility of the retrograde approach of using bilateral radial arteries for CTO has been demonstrated in previous studies conducted by TR PCI experts.10 The relative size of the radial and ulnar arteries is a common anatomical variation. The ulnar artery mean diameter was 2.7 6 ± 0.42 mm that could be larger or smaller than the radial artery branching from the same branchial artery or even reported to be similar in size.6,13 Via a TU approach, 4 and 5 French sheaths and catheters were used for diagnostic purposes in most of the cases. 6F sheaths were needed in 46%, when demanding techniques such as the kissing balloon technique, intravascular ultrasound, and rotational atherectomy, with high success and low complication rates. 7 Fr equipment could be used for only 0.43% of the cases.14 In our unpublished data, 7F was used in 3 of 76 (3.9%) cases only. The advantages of using the TU approach for this patient were as follows. First, it was selected when anatomically larger than the ipsilateral radial artery, which may be allowable for 7F and even 8F catheters. Second, we always try to avoid compromising the deep palmar arch originating from the radial artery (which is complete in up to 98% of humans).13 Third, the ulnar artery was considered a reasonable alternative because the patient had a history of previous TR PCI via the left radial artery. Fourth, the incidence of an access site vascular complication is higher with the transfemoral than the TR approach,13 so that TU also deserved to be considered. Fifth, TR catheterization and PCI have been found to induce intimal hyperplasia at the access site, and they may reduce patency of the radial artery when used as a conduit graft. We also assumed that there was no reason to decline the retrograde approach, and that it could be performed using biulnar arteries with adequate diameters for the 7F sheath. In our case, the bilateral ulnar approach was successful with retrograde recanalization using the CART technique and then stenting the RCA CTO lesion.

**Limitations of bilateral ulnar approach:** Similar to the TR approach, there is a learning curve for the TU approach, but this should be a minor issue for experienced TR PCI operators. The limitation could be due to the different anatomical orientation of the ulnar artery (which lies deeper and is closely related to the ulnar nerve), and there is a chance of traumatic injury due to needle puncture. Perioperative assessment of hand circulation by physical examination or Doppler study is recommended, especially in patients with a history of TR PCI. Multiple radial punctures may cause unilateral or bilateral radial artery occlusion or atrophy. Before attempting the TU approach, the operator should be aware of these considerations to avoid the rare complication of severe hand ischemia after TU intervention.

**Conclusion:** To the best of our knowledge, this is the first case of a successful TU retrograde approach for PCI of a CTO lesion in a patient with bilateral small radial arteries with the intention of preserving deep palmar arch integrity.

**References**

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