Case Report

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Dorsal-Plantar Loop Technique Using Chronic Total Occlusion Devices via Anterior Tibial Artery

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The effectiveness of below-the-knee (BTK) percutaneous transluminal angioplasty to obtain successful revascularization in patients with critical limb ischemia has been well established, and many of these patients with chronic lower-extremity disease have been treated by endovascular intervention as the firstline treatment. Dorsal-plantaer loop technique is one of the new BTK interventional techiniques, and includes recanalization of both pedal and plantar arteries and their anatomical anastomoses. This method generally needs two approaches simultaneously, including antegrade and retrograde. In this report, however, we describe a case in which dorsal-plantar loop technique with only one antegrade approach, using chronic total occlusion devices via anterior tibial artery, was used to successfully recanalize BTK arteries. We think that this new technique, which may represent a safe and feasible endovascular option to avoid more invasive, time-consuming, and riskier surgical procedures, especially in end-stage renal disease and diabetes, should be considered whenever the foot is at risk, and results of above-the-ankle percutaneous transluminal angioplasty remain unsatisfactory or insufficient to achieve limb salvage.

Key Words: Ischemia, peripheral arterial disease, angioplasty

INTRODUCTION

Peripheral arterial disease of the lower extremities usually results from extensive atherosclerotic occlusive disease of the lower limb arteries, and presents with claudication or critical limb ischemia (CLI). In patients with end-stage renal disease (ESRD) and diabetes, this disease is accompanied with foot ulcers and/or gangrene and represents the leading cause of requiring a lower limb amputation.[1] Improvement in arterial circulation of the foot is essential to accelerate the healing of trophic alterations and to relieve the pain.[2] We report a case of successful recanalization of below-the-knee (BTK) arteries which was treated by dorsal-plantar loop technique using chronic total occlusion (CTO) devices via anterior tibial artery.

CASE REPORT

A 61-year-old male was admitted to our hospital due to a nonhealing diabetic ulcer management and transferred from orthopedics. He had a history of hypertension, diabetes, and 40 pack years smoking, and had received percutaneous transluminal angioplasty with stent implantation at right superficial femoral artery. He presented with extensive ulceration localized at dorsum, sole and toes of the left foot, persistent rest pain, and a Rutherford classification of grade 5.[3] On physical examination, we could feel the arterial pulse at the femoral and popliteal levels, but the pulse of left dorsalis pedis artery was not palpable. Before angiography, we checked computed tomography of the lower-extremities, but the result was confusing because of severe calcification.

The left common femoral artery was punctured, and a 5 Fr Ansel sheath (Cook, Bloomington, IN, USA) was moved into the left popliteal artery and then diagnostic angiography was performed. Baseline angiography showed total occlusion of the left infrapopliteal artery with proximal portion of three distal run-off vessels (Fig. 1A and B). The first target vessel for recanalization was posterior tibial artery (PTA) because of the site of the ulcer. However, we could not see the ostium of PTA, and wiring through PTA and anterior tibial artery (ATA) was difficult. Therefore, wiring through the peroneal artery was done, and balloon angioplasty was then conducted at the left peroneal artery. After peroneal artery balloon angioplasty, we could see distal flow of PTA, however, an attempt to move the wire to the ostium of PTA was unsuccessful. Since diffuse wound was distributed on the entire area of the foot and we could not find the puncture site (Fig. 1C and D), transpedal retrograde approach could not also be performed. Therefore, we tried to pass the wire through the ATA, but wiring through ATA failed. We decided to pass the wire using subintimal approach method. The wire through the true lumen of ATA was confirmed by the use of contrast injection, and then balloon angioplasty was performed using 3.0×100 mm EverCross balloon (ev3 Inc., Plymouth, MN, USA). Next, we tried to pass the wire through the ostium of PTA again, but failed. Finally, dorsal-plantar loop technique via the anterior tibial artery with CTO devices was performed as an alternative method. A 300-cm-long 014-inch hydrophilic guidewire (PT2; Boston Scientific, Natick, MA, USA) using the Corsair microcatheter (Asahi Intecc Co. Ltd., Aichi, Japan) could be advanced antegradely from distal ATA via dorsal-plantar loop (consisting of dorsalis pedis artery, deep plantar artery, deep plantar arch and lateral plantar artery) to proximal PTA. When balloon angioplasty was tried with 2.0×120 mm NanoCross balloon (ev3 Inc., Plymouth, MN, USA), the balloon could not penetrate toward proximal PTA because of resistance. Therefore, we extracted the wire, which was retrogradely passed from ATA via the left femoral sheath by using snare catheter (pfm medical ag, Köln, Germany). After successful wire passage, balloon angioplasty was performed with 3.0×100 mm EverCross balloon, penetrating from proximal to distal part of PTA (Fig. 2). Final angiography demonstrated a well visualized anterior tibial artery, dorsal-plantar loop, and posterior tibial artery with improved flow (Fig. 3). After 24 hour of observation, the patient was transferred to an orthopedics without complications, and then wound healing was achieved by surgical repair by necrotic tissue debridement and skin graft.

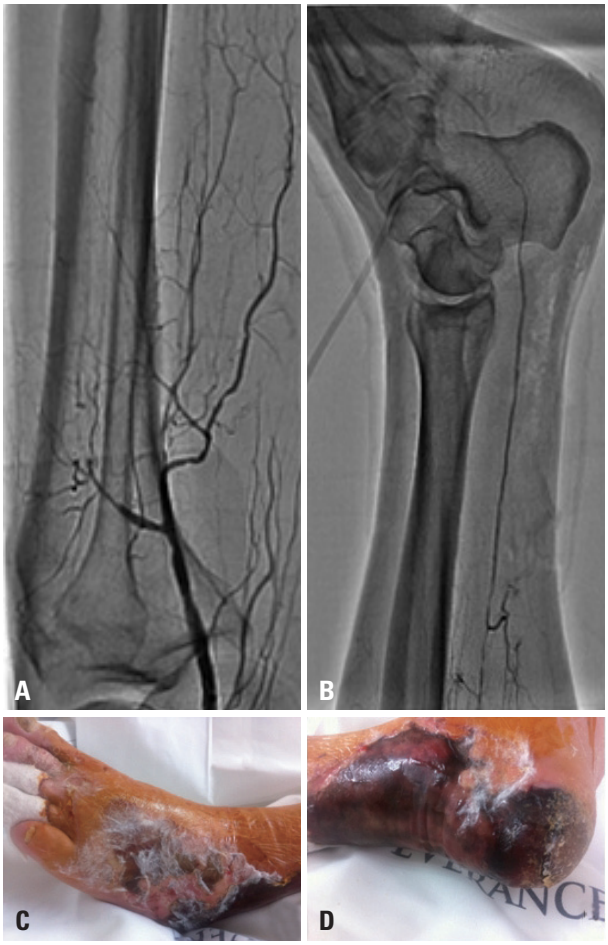

Fig. 1. Baseline peripheral angiography. (A) Baseline angiography revealed total occlusion of the left infrapopliteal artery with proximal portion of three distal run-off vessels. (B) The flow of distal posterior tibial artery and lateral plantar artery is shown. (C and D) A diffuse wound is distributed on the entire area of the foot including the transpedal puncture site.

Fig. 2. Balloon angioplasty. (A and B) Balloon angioplasty of ATA using 3.0×100 mm EverCross balloon. (C) A 300-cm-long 014-inch hydrophilic guidewire was passed from ATA via a dorsal-plantar loop to PTA using the Corsair microcatheter. (D, E and F) Balloon angioplasty of dorsal-plantar loop (consisting of dorsalis pedis artery, deep plantar artery, deep plantar arch and lateral plantar artery) using 2.0×120 mm NanoCross balloon. (G and H) Balloon angioplasty of PTA using 3.0×100 mm EverCross balloon. ATA, anterior tibial artery; PTA, posterior tibial artery.

Fig. 3. (A-D) Final angiography. Final angiography reveals a well visualized anterior tibial artery, dorsal-plantar loop and posterior tibial artery with improved flow.

DISCUSSION

Peripheral percutaneous transluminal angioplasty is a method for treating CLI, especially infrapopliteal level, with outcomes similar to those of bypass surgery.[4,5] Ultimate aim of revascularization in patients with CLI is to prevent limb loss, including major amputation to improve patient's quality of life, and to prolong survival. However, BTK intervention may be very challenging until recently because it is often necessary to treat very long occlusions of BTK vessels. The typical patient group of complex BTK lesions represents an increasing population of patients due to increasing prevalence of diabetes and ESRD. In addition to that, although limb salvage rates are low, the endovascular intervention have the advantage of safety and low morbidity, and might offer economical benefits, especially in patient with ESRD and diabetes. Diabetic foot ulcer occupy about 15% in patients with type 2 diabetes during their lifetime, and approximately 20% of these end up with some kind of amputation.[6] Therefore, multiple interventional devices and techniques available can offer patients with treatment options for diseased arterial territories that have not traditionally been amenable to treatment, especially BTK interventions.

Dorsal-plantaer loop technique is one of the new BTK interventional techiniques and includes recanalization of both pedal and plantar arteries and their anatomical anastomoses, and this method generally needs two simultaneous approaches, including antegrade and retrograde.[7,8] Manzi, et al.[9] reported excellent results in clinical study showing 85% of acute success rate, 86% of limb salvage rate and 7.5 to 8% of repeated target vessel percutaneous transluminal angioplasty among 135 patient approached with dorsal-plantar loop techinique. Most of diabetic ulcers are formed in distal part of the foot, and the arteries of the foot are terminal branches of ATA and PTA, dorsal and plantar arteries, respectively, and these arteries are the major source of blood supply to toes, dorsum and sole of foot.[10] Therefore, revascularization of these arteries plays an important role in limb salvage and is a treatment for patients with non-healing ulcers and possible limb loss. This patient underwent complex interventions with dorsal-plantar loop techinique, which included only one antegrade approach using CTO devices via ATA, with good results.

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