

➤ **Case Report** ◀

A Simple Reproducible Method to Treat Acute or Subacute Arterial Obstruction When the Thrombus Is Adherent to the Arterial Wall

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We report three consecutive patients with limb ischemia, where symptoms appeared several days to weeks prior to presentation. In all cases, initial over-the-wire thrombectomy failed due to adherence of the thrombus to the arterial wall. We adopted a new approach of stretching the whole obstructed segment by a series of ballooning using a percutaneous transluminal angioplasty (PTA) catheter. A subsequent thrombectomy was successful in all three cases. No further intervention, such as stenting or bypass surgery, was required. The adhering thrombus was dissected by stretching the arterial wall at the site of obstruction.

Keywords: organized thrombus, arterial stretch procedure, dissect adhering thrombus

Introduction

Organized thrombi are often resistant to Fogarty catheter thrombectomy in patients with subacute limb ischemia. A mechanical thrombectomy device is currently an option for these patients.^{1,2} However, in Japan, mechanical thrombectomy devices are not available for the treatment of peripheral artery obstruction within the National Health Insurance system. Therefore, in the present cases, we stretched the obstructed artery using percutaneous transluminal angioplasty (PTA) balloon inflation to

dislodge the entire organized thrombus. Next, we successfully removed the thrombus by repeated Fogarty procedure, thereby ruling out the need for bypass surgery. Our method is simple, useful, and less invasive in treating arterial obstruction with an organized thrombus.

Case Reports

Case 1

A 70-year-old man noticed intermittent claudication of his left lower leg on February 12, 2011 when playing badminton or climbing stairs. He visited our outpatient department on March 8, 2011. His femoral arterial (FA) pulses were palpable, but not the popliteal, dorsalis pedis, and posterior tibial arterial ones. Computed tomography (CT) revealed complete obstruction of the left distal superficial femoral artery (SFA) and popliteal artery (PA), with patency of the three branches of the lower leg. Electrocardiography (ECG) showed atrial fibrillation, indicating that his obstruction was embolic. We operated him on March 18, 2011, 34 days after the onset of symptoms. The left groin was cut down and FA was exposed under local anesthesia. A guidewire was inserted through FA to the posterior tibial artery. The first series of the Fogarty maneuver failed to remove a large portion of the embolus (Fig. 1A), possibly due to the organization and adhesion of the embolus to the vessel wall. Intravascular ultrasound (IVUS) revealed the remaining intravascular embolus, which was focal and highly echogenic and moved with pulsation (Fig. 1B). We attempted to stretch the obstructed segment by a series of PTA balloon inflations, increasing the pressure to 6 atmospheres (Fig. 1C). The second series of the Fogarty maneuver succeeded in removing several large pieces of the embolus. IVUS (Fig. 1D) and angiography (Fig. 1E) revealed no remaining embolus within the lumen. The postoperative course was uneventful. A subsequent CT showed complete patency of the left SFA, PA, and distal arteries, with a smooth inner surface, prior to discharge (Fig. 1F). The patient is doing well 5 years and 4 months after the surgery without symptom recurrence.

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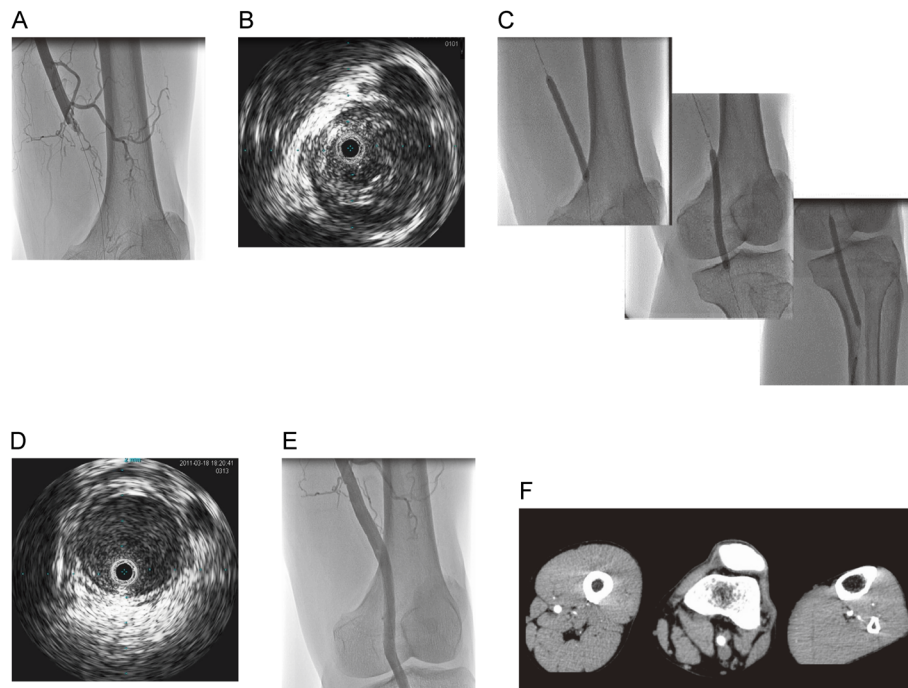


Fig. 1 (A) Angiography after the first series of the Fogarty maneuver. The distal superficial femoral and popliteal arteries were still completely obstructed. (B) Intravascular ultrasound after the first series of the Fogarty maneuver. The embolus had a mosaic echo pattern, indicating a mixed thrombus. (C) Serial arterial stretch using percutaneous transluminal angioplasty balloon inflation of the remaining embolus. The balloon was 6 mm in diameter and 80 mm in length. (D) Intravascular ultrasound after the second series of the Fogarty maneuver. No embolus remained. (E) Angiography after embolectomy. No obstruction was found. (F) Postoperative enhanced computed tomography. The patent artery had a smooth inner surface. No vascular injury was seen after embolectomy. Left: lower-thigh level; middle: knee level; right: below-knee level.

Case 2

A 69-year-old man suffered from intermittent claudication of his left leg. CT demonstrated an ectatic and 15-mm obstruction extending from the left SFA to PA. ECG revealed no arrhythmia. He developed foot pain at rest. On the 19th day after onset, we attempted thrombectomy under local anesthesia through a groin incision. The first series of the Fogarty maneuver failed. We stretched the obstructed segment of the artery using PTA balloon inflation. A 6-mm diameter balloon did not produce any effect, but an 8-mm diameter balloon enabled the removal of a large portion of the thrombus after a second Fogarty maneuver (Fig. 2A). The inflating pressure was as low as 4 atmospheres. The removal of SFA and PA thrombi revealed complete obstruction of the anterior and posterior tibial arteries (Fig. 2B). We stretched these obstructed segments with a 2.5 mm-diameter balloon and performed the Fogarty maneuver, with no effect. These segments were thought to be chronically obstructed. We completed the procedure when the peroneal artery was determined to be patent. Pain and claudication dramatically improved. Pathological evaluation showed that the thrombus was of a mixed type, with

both chronic (organized) and acute portions. The patient is doing well 4 years and 10 months after the surgery without symptom recurrence.

Case 3

A 54-year-old man visited our hospital complaining of coldness and paresthesia in his left arm; however, the onset was unclear. Pulsation was absent in the left brachial artery and its distal branches. CT showed left axillary arterial obstruction. The first Fogarty maneuver, performed through the left brachial artery, removed a small amount of fresh thrombus; although a large portion of the thrombus remained. The obstructed arterial segment was stretched with 6- and 8-mm diameter PTA balloons inflated at a pressure of 4 atmospheres. Subsequent Fogarty maneuvers successfully relieved the obstruction. The postoperative course was uneventful. Blood pressure was equal in both the arms. The patient was later diagnosed with pharyngeal cancer. Hypercoagulability tendency could have played a role in his thromboembolism, although the exact etiology of the obstruction remains unclear. The patient has not experienced symptom recurrence for 4 years and 7 months after the surgery.



Fig. 2 (A) Angiography after arterial stretching. The superficial femoral and popliteal arteries were completely patent. (B) Angiography of the below-knee segment. The anterior and posterior tibial arteries were obstructed. The patent peroneal artery collaterally communicated with the anterior tibial artery at the foot joint level.

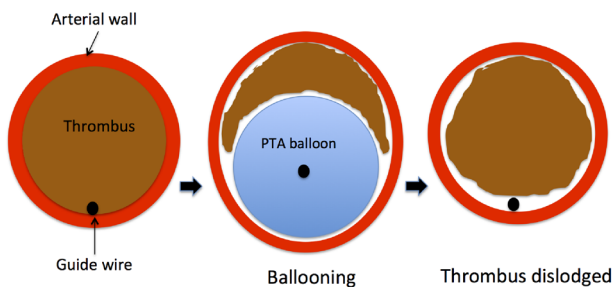


Fig. 3 Schema showing our understanding of the mechanism of thrombus dissection. I: guidewire in place; II: balloon-stretching the arterial wall; III: dissection of the thrombus.

Discussion

Two of the three cases presented in this report involved subacute limb ischemia, wherein the thrombus stage was classified as follows: acute obstruction, ≤ 14 days old or subacute obstruction, 15–90 days old.¹⁾ The interval from onset was relatively long, and the symptoms showed gradual progression. The thrombi were adherent to the arterial wall due to which the first series of the Fogarty maneuver was unsuccessful. According to reports on coronary thrombosis, thrombus organization begins approximately 5 days after thrombus formation.^{3,4)} The duration

of symptoms in cases 1 and 2 were long enough for the thrombi to become organized.

To remove the organized thrombi, we stretched the arterial wall using PTA balloon inflation, which resulted in the dissection of the thrombus from the arterial wall and allowed successful removal during a subsequent series of the Fogarty maneuver. This dissection mechanism, referred as “arterial stretch,” is based on the differential effect of stretching on the arterial wall and thrombus, which produces shear force, leading to the dissection of the entire thrombus from the wall (Fig. 3). It resulted in complete relief from obstruction, except the chronically obstructed tibial arteries in case 2. This arterial stretch procedure does not fragment the thrombus. The excised thrombus was divided into large blocks in each case, and this represents a significant advantage of our method. Our method clearly uses a different mechanism from mechanical thrombectomy. A previous study on percutaneous mechanical thrombectomy¹⁾ reported the occurrence of peripheral embolization as a complication in 24% of patients. In the same study, primary and secondary patency rates were 39% and 68% after one year of the procedure, respectively. In our patients, thrombi were completely removed without any complication when using the appropriate balloon size and pressure. Our technique is a hybrid procedure where the Fogarty catheter is manipulated, while the affected artery is clamped, which helps in avoiding peripheral embolization. Each patient maintained primary patency for several years (4.5–5.3 years). A previous study regarding the treatment of thrombosed arteriovenous fistula in dialysis patients revealed that the hybrid procedure was better than percutaneous mechanical thrombectomy in terms of technical success and patency rates.⁵⁾

Another study used a Dormia catheter in the same situation as ours.⁶⁾ Also, a previous study used a PTA balloon to de-clot the obstructed dialysis access grafts.⁷⁾ However, the dislodgement of an organized thrombus using PTA balloon approach for peripheral arterial obstruction has not been described. In Japan, the use of mechanical thrombectomy device for peripheral arterial obstruction is not permitted by the Ministry of Health, Labor, and Welfare. Our method, which does not require any special device, is simple and much less invasive than bypass surgery. Our procedure can be safely and easily attempted, whenever the standard Fogarty maneuver fails.

We believe our technique is effective for acute and subacute thromboembolism, but ineffective for chronic obstruction, as observed in case 2, where we attempted arterial stretching.

Arterial stretch using PTA balloon inflation has the potential risk of dissection or rupture, especially when the obstructed artery is ectatic, as observed in case 2. Re-

garding the PTA balloon size, a balloon diameter smaller than or equal to that of the a native vessel was sufficient. Regarding delivering pressure, a maximum pressure of 6 atmospheres was sufficient according to our preliminary experience. Some reports stated that balloon diameter has a greater influence than delivering pressure of the dilation force.⁸⁾ However, practitioners should note that an oversized balloon carries a greater risk of vessel injury.⁹⁾

A Fogarty adherent clot catheter may be an alternative option, which was not attempted in the current cases. Further research is warranted to compare the efficacy and risks between our method and the adherent clot catheter method. To the best of our knowledge, there has not been any large-scale study assessing the usefulness and complications of the Fogarty adherent clot catheter method for late arterial thromboembolism; only Yang et al.¹⁰⁾ did not find the Fogarty adherent clot catheter method to be superior to the standard Fogarty catheter method in the treatment of obstruction of hemodialysis arteriovenous fistulas.

Conclusion

We reported three consecutive cases where patients passed the acute phase of arterial thromboembolism. The standard Fogarty procedure failed in this situation due to the thrombus adhering to the arterial wall. We successfully dissected the adherent thrombi by stretching the affected artery using a PTA catheter. This approach can be an alternative option before performing additional procedures, such as stenting or bypass surgery.

Disclosure Statement

None of the authors have any conflicts of interest.

Author Contributions

Study conception: HN, MT

Data collection: HN

Investigation: HN

Writing: HN

Critical review and revision: all authors

Final approval of the article: all authors

Accountability of all aspects of the work: all authors

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