American Journal of Case Reports

e-ISSN 1941-5923
© Am J Case Rep, 2022; 23: e936377
DOI: 10.12659/AJCR.936377

Received: 2022.02.14
Accepted: 2022.05.04
Available online: 2022.05.19
Published: 2022.06.28

Successful Percutaneous Fogarty Thrombectomy for Subacute Lower Limb Ischemia Due to Resistant Thrombus in the Popliteal Artery

Authors' Contribution:
Study Design A
Data Collection B
Statistical Analysis C
Data Interpretation D
Manuscript Preparation E
Literature Search F
Funds Collection G

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Financial support: None declared
Conflict of interest: None declared

Patient: Male, 73-year-old
Final Diagnosis: Subacute lower limb ischemia
Symptoms: Coldness • pallor • numbness • rest pain of the right toes
Medication: —
Clinical Procedure: Percutaneous Fogarty thrombectomy
Specialty: Cardiac Surgery • Cardiology

Objective: Unusual setting of medical care

Background: Subacute lower limb ischemia occurs more than 14 days and less than 3 months from symptom onset. Although endovascular procedures are the preferred treatment choice for a viable and not immediately threatened limb in patients with acute lower limb ischemia (<14 days), percutaneous catheter-directed thrombolysis, percutaneous mechanical thrombectomy, or percutaneous thromboaspiration are not recommended, and no treatment strategy has yet been established for nonacute lower limb ischemia (>14 days). A percutaneous Fogarty thrombectomy, an endovascular thrombus removal procedure with the use of a large-caliber sheath and a Fogarty balloon catheter, has recently been reported as a less invasive alternative to open surgery in patients with acute lower limb ischemia. In this report, we use this technique for a case of subacute lower limb ischemia caused by a resistant thrombus.

Case Report: A 73-year-old man with a diagnosis of essential thrombocythemia presented with symptoms of right lower limb ischemia, which started about a month before. The diagnosis was subacute lower limb ischemia due to a resistant thrombus in the popliteal artery. First, we attempted percutaneous thromboaspiration and prolonged dilation with a large-caliber balloon catheter, but there were still severe residual stenoses with delayed blood flow. Although vascular scaffold implantation might have achieved complete revascularization, we avoided it because of a high probability of stent fracture in the popliteal artery. Thus, we performed a subsequent percutaneous Fogarty thrombectomy immediately after the conventional endovascular recanalization failed, achieving complete revascularization and next-day discharge without any complications.

Conclusions: A percutaneous Fogarty thrombectomy could be a new treatment option for subacute lower limb ischemia due to a resistant thrombus, which can be performed immediately after failure of the conventional endovascular recanalization.

Keywords: Catheterization, Peripheral • Endovascular Procedures • Thrombectomy • Thrombosis

Full-text PDF: https://www.amjcaserep.com/abstract/index/idArt/936377

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Background

Subacute lower limb ischemia is defined as occurring more than 14 days and less than 3 months from symptom onset [1,2]. Although endovascular procedures such as percutaneous catheter-directed thrombolysis (CDT), percutaneous mechanical thrombectomy (PMT), or percutaneous thromboaspiration (PAT) are the preferred treatment choice for a viable and not immediately threatened limb in patients with acute lower limb ischemia (<14 days), these are not recommended, and no treatment strategy, to the best of our knowledge, has been established for nonacute lower limb ischemia (>14 days).

A percutaneous Fogarty thrombectomy is an endovascular thrombus removal procedure with the use of a large-caliber sheath and a Fogarty balloon catheter. It is a less invasive alternative to open surgery in patients with acute lower limb ischemia with occlusion of the middle or distal superficial femoral artery (SFA) or the popliteal artery [3]. Here, we report a case of subacute lower limb ischemia due to a resistant thrombus in the popliteal artery that was successfully treated by a percutaneous Fogarty thrombectomy immediately after a failed conventional endovascular recanalization.

Case Report

A 73-year-old man with a history of hypertension was referred to our hospital because of coldness, pallor, numbness, and rest pain of the right toes, which suddenly started about a month ago. He did not have a history of atrial fibrillation or atherosclerotic disease. A complete blood count on admission revealed thrombocytosis (678×10^9/L). The diagnosis of essential thrombocythemia was made by bone marrow biopsy at a later date after hospital discharge. The right ankle-brachial index was 0.53, although it was normal a half year ago. Duplex ultrasound detected an absence of blood flow in the right popliteal artery, and computed tomographic angiography confirmed middle popliteal artery occlusion.

A 6 Fr low-profile sheathless guiding catheter (Destination, Terumo Medical Corp, Somerset, NJ, USA) was inserted in the ipsilateral right common femoral artery (CFA) under ultrasound guidance with local anesthesia for diagnosis and intervention. Baseline angiography identified complete occlusion in the P2 segment. The distal popliteal artery was supplied by an ipsilateral collateral pathway (**Figure 1**). A 0.014-in. tapered guidewire with a tip load of 12 g (Astato 9-12, Asahi Intecc Co, Ltd, Seoul, Korea) supported by a microcatheter (Caravel, Asahi Intecc Co, Ltd) penetrated the proximal cap of the obstructed popliteal lesion and was intraluminally advanced. Intravascular ultrasound (IVUS) showed an isoechoic-to-hyperechoic lesion

Figure 1. Pre-procedural digital subtraction angiography. Baseline angiography showed complete occlusion of the right P2 segment. An ipsilateral collateral pathway (arrowheads) supplied the distal popliteal artery.

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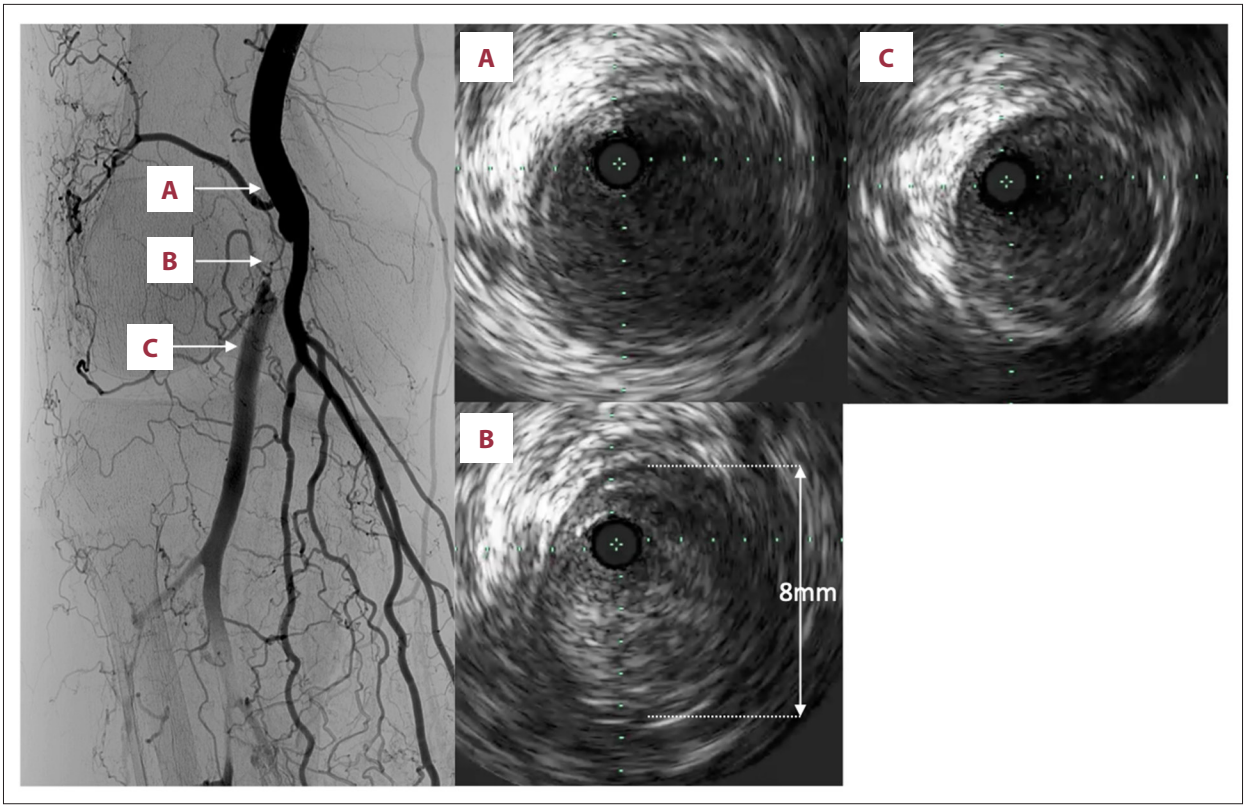

Figure 2. Intravascular ultrasound. (**A**) A proximal reference segment. (**B**) Intravascular ultrasound examination of the target lesion showed an isoechoic-to-hyperechoic lesion with no backward signal attenuation and no dense calcium. The diameter of the popliteal artery was 8 mm. (**C**) A distal reference segment.

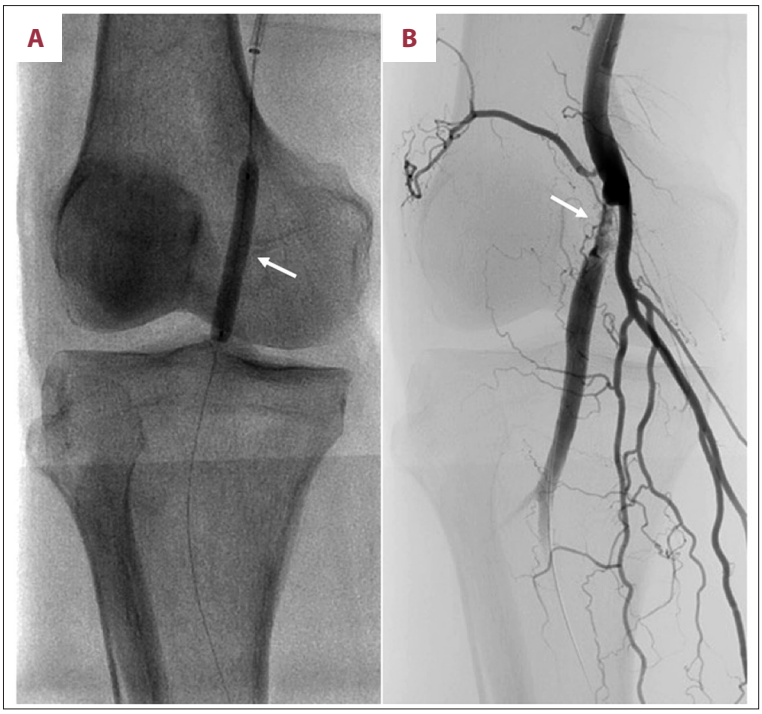

Figure 3. Conventional endovascular procedure. Angiography after plain balloon angioplasty of a right popliteal occlusive lesion (**A,** arrow) confirmed severe residual stenosis with delayed blood flow (**B,** arrow).

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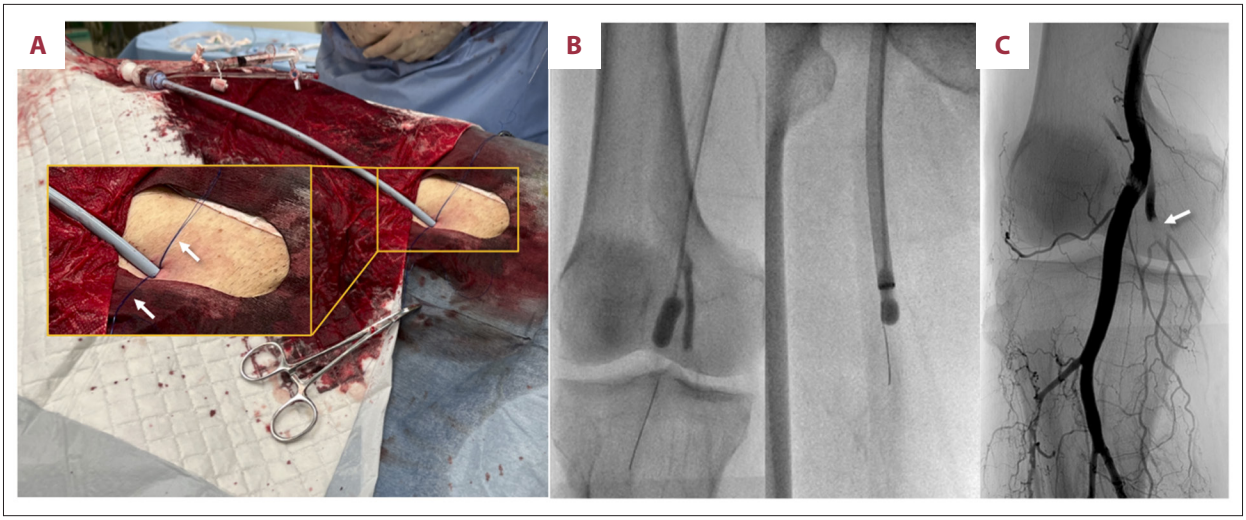

Figure 4. Percutaneous Fogarty thrombectomy. (**A**) A 16 F DrySeal sheath was placed under local anesthesia in the common femoral artery using a double preclose technique (arrows). (**B**) Arterial thrombectomy using a 5 F Fogarty balloon catheter. (**C**) Final angiography confirmed the disappearance of the thrombus in the P2 segment and new thrombotic occlusion of the collateral artery from the superior genicular artery (arrow).

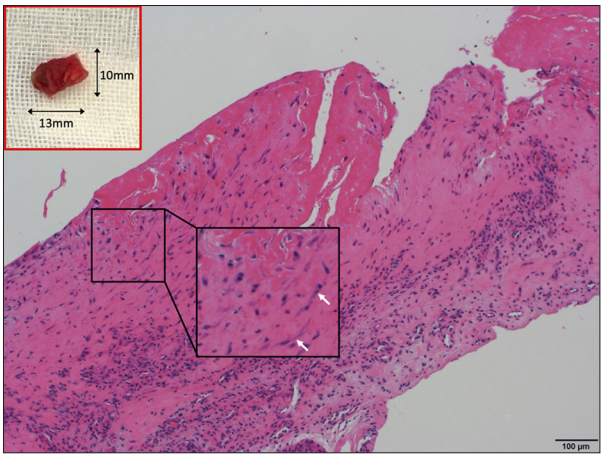

Figure 5. Removed thrombus. The red box includes the removed thrombus consistent with angiographic findings. Histopathological analysis showed a well-organized thrombus with ingrowth of spindle-shaped cells (arrows).

without backward signal attenuation and no dense calcium (**Figure 2**). This finding is considered an obstruction by a resistant thrombus. Clinical and imaging findings were consistent with the diagnosis of Rutherford class IIa right subacute lower limb ischemia. Only a few thrombi were removed by conventional catheter aspiration, and the entire occlusive lesion was dilated with a balloon catheter (6.0×40 mm) (**Figure 3A**); however, severe stenosis with delayed flow remained and the coldness and pallor of his right toes did not improve (**Figure 3B**). We avoided implantation of a vascular scaffold in the middle popliteal artery in this ambulatory patient because the popliteal artery is under particularly pronounced mechanical stress, making it susceptible to increased stent fracture and occlusion. Thus, we decided to perform a subsequent immediate percutaneous Fogarty thrombectomy.

After 2 Proglide (Abbott Vascular, Abbott Park, IL, USA) devices were deployed using a double preclose technique, each system was rotated 30° from the midline (at 11 and 1 o'clock) during deployment. Both suture systems were secured, then the sheathless guiding catheter was exchanged for a 16 Fr DrySeal sheath (W. L. Gore & Associates, Newark, DE, USA) (**Figure 4A**). An outer diameter of the large-caliber sheath was selected equal to the proximal SFA to eliminate antegrade blood flow by wedging the sheath to the SFA and to perform an efficient thrombectomy. An arterial thrombectomy was performed using a 5 F Fogarty balloon catheter (Edwards Lifesciences, Irvine, CA, USA) (**Figure 4B**). A thrombus concordant with the angiographic findings was removed. A subsequent histopathological analysis showed a well-organized thrombus with ingrowth of spindle-shaped cells (**Figure 5**). After establishing forward flow by pulling out the 16 Fr DrySeal sheath from the proximal SFA to the CFA, an angiography via a 6 Fr straight guiding catheter (Autobahn, Nipro Medical Corporation, Osaka, Japan) inserted in the 16 Fr DrySeal sheath revealed disappearance of the thrombus in the P2 segment, new thrombotic occlusion of the collateral artery from the superior genicular artery (**Figure 4C**), and occlusion of all 3 below-the-knee arteries (**Figure 6A**). We considered that the construction of in-line blood flow to the ankle was the most important, and the occlusive anterior tibial artery was dilated with a balloon catheter (3.0×100 mm). The final angiography confirmed excellent recanalization (**Figure 6B**).

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Figure 6. Below-the-knee angioplasty. (**A**) Below-the-knee angiography before the revascularization showed the occlusion of all three arteries. (**B**) The occlusive anterior tibial artery was successfully dilated (arrows) with a balloon catheter.

The 16 Fr DrySeal sheath was removed with sequential advancement of the pre-deployed suture knots. Complete hemostasis was achieved in combination with manual compression for 10 min. After revascularization, the right ankle-brachial index increased from 0.53 to 1.03. The patient was discharged without right leg symptoms the day after intervention.

Discussion

In patients with acute lower limb ischemia, endovascular procedures such as CDT, PMT, or PAT should be the preferred choice of treatment for a viable and not immediately threatened limb [4]. In the present case, symptom duration before the angiography was a month or more. The occlusive lesion was not easy to cross with a soft guidewire, and intravascular ultrasound showed an isoechoic-to-hyperechoic lesion, implying subacute lower limb ischemia due to a resistant thrombus.

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In previous reports with CDT, although 75% to 92% of patients with acute lower limb ischemia with an occluded native vessel achieved complete or partial thrombus resolution with a satisfactory clinical result, those with symptoms of longer duration (>14 days) had a worse outcome after CDT compared to that of surgical revascularization [1,2]. PMT is defined as endovascular thrombus maceration and removal with dedicated percutaneous thrombectomy devices (PTDs). Very high technical success rates (over 90%) for primary revascularization of lower limb arteries with PMT have been reported [5,6]; however, resistant thrombi are still challenging for most PTDs. Moreover, dedicated PTDs are not available in Japan. PAT with or without mechanical clot fragmentation using angioplasty balloon catheters has also been a proven effective technique for acute lower limb ischemia [7,8]. In our case, there were still severe residual stenoses with delayed blood flow even after PAT and long dilation with a large-caliber balloon catheter. Although implantation of a vascular scaffold might have achieved complete revascularization, we avoided it because of a high probability of stent fracture in the popliteal artery. Thus, we decided to perform Fogarty thrombectomy.

Although surgical arterial thrombectomy using a Fogarty balloon catheter is the criterion standard of thrombus removal, the early clinical outcome still remains unsatisfactory in numerous cases [9]. This might be related to the incomplete restoration of perfusion in below-the-knee arteries or the presence of underlying atherosclerotic lesions. It has been reported that intraoperative angiography can detect such arterial imperfections [10] and guide adjunctive endovascular procedures [11]. During the procedure of percutaneous Fogarty thrombectomy, confirmatory angiography and adjunctive endovascular treatment are easier than open thrombectomy. After establishing forward flow by pulling out the large-caliber sheath from the wedged proximal SFA to CFA, angiography via a guiding catheter inserted in the large-caliber sheath can confirm the residual thrombosis and atherosclerotic lesions and, if necessary, subsequent percutaneous thromboaspiration with or without CDT and balloon angioplasty can be performed, especially for below-the-knee arteries.

A percutaneous Fogarty thrombectomy has 2 more key advantages over an open approach. First, performing the preclose double Proglide technique can reduce wound complications, minimizing the time to ambulation and hospital stay compared with that achieved via femoral cutdown [12,13]. In the present case, the patient was discharged without any complications the day after the intervention. Second, the procedure can be performed immediately after a failed conventional endovascular recanalization, including dilation with a large-caliber balloon catheter that sometimes leads to successful reperfusion, especially for a subacute lower limb ischemia caused by a resistant thrombus.

The major limitation of the present procedure was a device-specific risk related to the intra-arterial foot of the vascular closure device, which may cause arterial wall dissection. It should be confirmed that the vessel is not diseased and large enough at the puncture site. Moreover, acute or subacute lower limb ischemia with occlusion in the proximal SFA, CFA, and iliac artery cannot be adapted to this procedure.

Conclusions

This case suggests that percutaneous Fogarty thrombectomy could be an additional treatment option for subacute lower limb ischemia due to a resistant thrombus in the middle or distal SFA or popliteal artery.

Acknowledgements

The authors thank the staff in the catheterization laboratory at Rakuwakai Otowa Hospital for their technical assistance during the procedure.

Declaration of Figures' Authenticity

All figures submitted have been created by the authors who confirm that the images are original with no duplication and have not been previously published in whole or in part.

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