—Case Reports—

Successful Treatment of Subacute Limb Ischemia by Thromboaspiration with an 8-Fr Long Sheath in a 10-Fr Short Sheath

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A 79-year-old man with a history of atrial fibrillation presented for evaluation of sudden onset of intermittent claudication of the left lower limb. An angiogram revealed thrombotic total occlusion of the left superficial femoral artery (SFA). A 10-Fr sheath was antegradely inserted into the left common femoral artery (CFA), and the guidewire penetrated the lesion. Thromboaspiration using an 8-Fr long sheath inserted into a 10-Fr short sheath was performed repeatedly. Intravenous anticoagulant was administrated immediately after endovascular treatment. Follow-up angiography performed 12 days after the procedure confirmed the absence of residual thrombus in the SFA. Thromboaspiration using a large-diameter catheter is a feasible, cost-effective strategy for treatment of acute and subacute limb ischemia.
(J Nippon Med Sch 2021; 88: 540–543)

Key words: acute limb ischemia, thrombectomy, endovascular procedure, thrombosis

Introduction

Acute or subacute limb ischemia (ALI/SLI) caused by a sudden decrease in blood perfusion to a limb is a clinical emergency because of the risk of eventual limb loss and life-threatening complications. ALI is a major cause of lower limb amputation. The incidence rate is approximately 1.5 per 10,000 persons per year[1], and prevalence is increasing because of the aging of the general population. There are 2 principal causes of ALI: arterial embolism (30% of cases) and thrombosis of an atherosclerotic artery (60%). Diagnostic and therapeutic delays may lead to irreversible ischemic damage. Therefore, expeditious diagnosis, accurate assessment, and urgent treatment are crucial in preventing major amputations and saving the affected limb.

Management of ALI depends on patient status, including ischemia severity, limb viability, presence of a disease lesion, age, and comorbidities. Anticoagulant therapy is the usual first and crucial step for treatment of ALI/SLI. Catheter intervention or surgical revascularization is frequently needed, especially in cases of severe ischemia. Percutaneous intervention offers 2 strategies for reperfusion: pharmacological thrombolysis and mechanical thromboaspiration. In patients without neurological deficits, catheter-directed thrombolytic therapy is the more appropriate treatment. In more severe cases with neurological deficits, extraction or aspiration of the thrombus and surgical therapy are preferable[2]. However, therapeutic strategies for percutaneous thromboaspiration are not well-established, and approaches vary by institution and in relation to the skill and preferences of the surgeon. Herein, we report the successful use of a large-diameter catheter system to perform thrombectomy for SLI. This strategy could prove to be the most feasible percutaneous method for ALI/SLI.

Case Report

A 79-year-old man presented to our outpatient clinic for evaluation of sudden onset of left leg fatigue and intermittent claudication within a walking distance of 100 m, which had begun 2 weeks' previously. Among the 5 characteristic ALI symptoms, ie, the "5 Ps" (pain, paresthesia,

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https://doi.org/10.1272/jnms.JNMS.2021_88-511
Journal Website (https://www.nms.ac.jp/sh/jnms/)

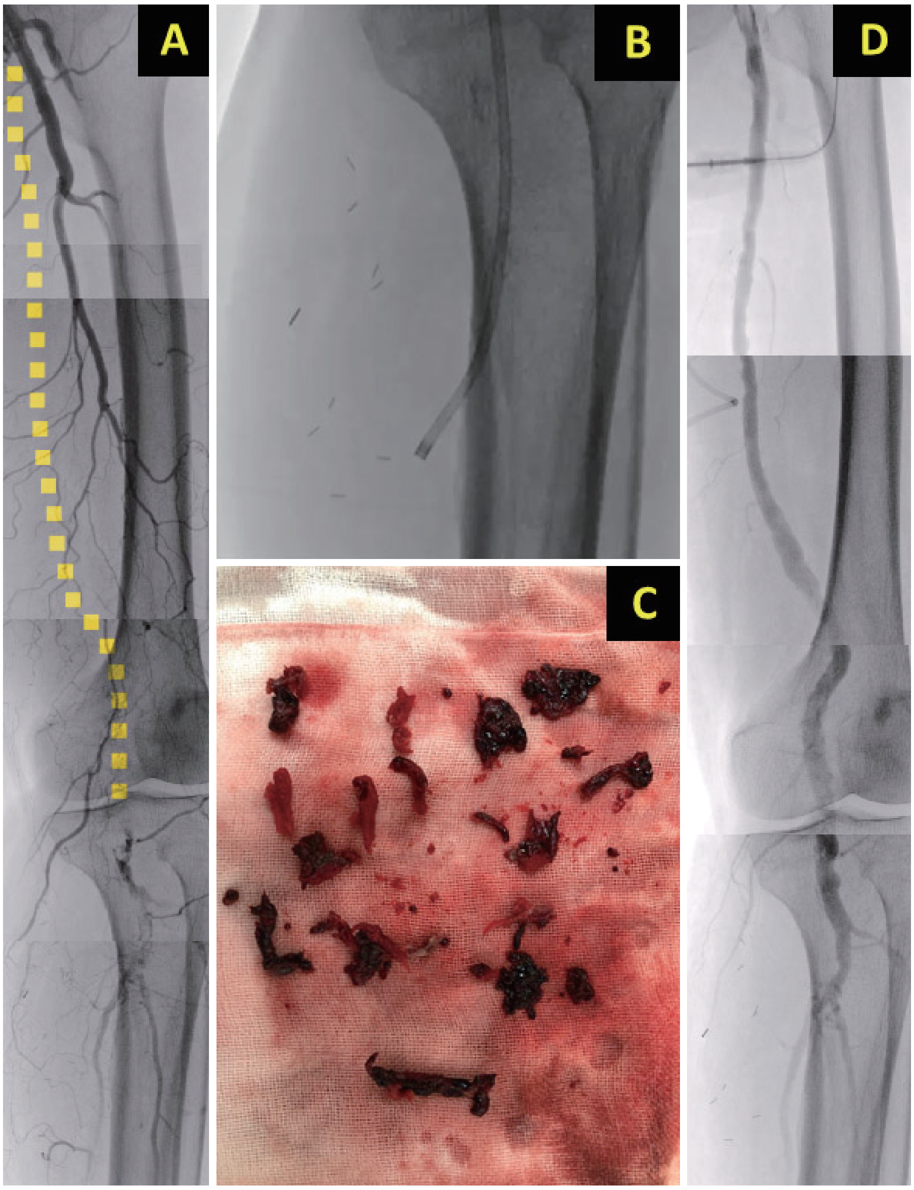

Fig. 1 Angiograms before and after the procedure
A. Initial angiogram showing total occlusion of the SFA and a floating thrombus at the popliteal artery.
B. Thrombectomy performed using an 8-Fr sheath.
C. Many thrombi were aspirated.
D. The number of thrombi was substantially lower at 12 days after the procedure.

pallor/paleness, pulseless, paralysis/paresis), the patient had pain, pallor/paleness, and pulseless of his left lower limb at presentation. The ankle brachial index (ABI) for his left leg had decreased to 0.57. His medical history included untreated atrial fibrillation, hypertension, dyslipidemia, coronary artery bypass graft surgery, and stage G3b chronic kidney disease (CKD). Because of the patient's stage G3b CKD, enhanced CT was not performed, to limit the amount of contrast media used. Angiography was performed directly and revealed thrombotic occlusion at the proximal segment of the left superficial femoral artery (SFA) and a floating thrombus at the popliteal artery (**Fig. 1A**). The final diagnosis of SLI (Rutherford ALI classification I) was consistent with the sudden onset of left leg fatigue and intermittent claudication, and with the thrombotic occlusion from the SFA to the popliteal artery on angiography. Fontaine IIb peripheral artery disease was considered in the differential diagnosis; however, the sudden onset of leg symptoms strongly indicated SLI. Endovascular thrombectomy was subsequently attempted as the first treatment. Catheter-directed thrombolysis seemed to be contraindicated, as immediate re-

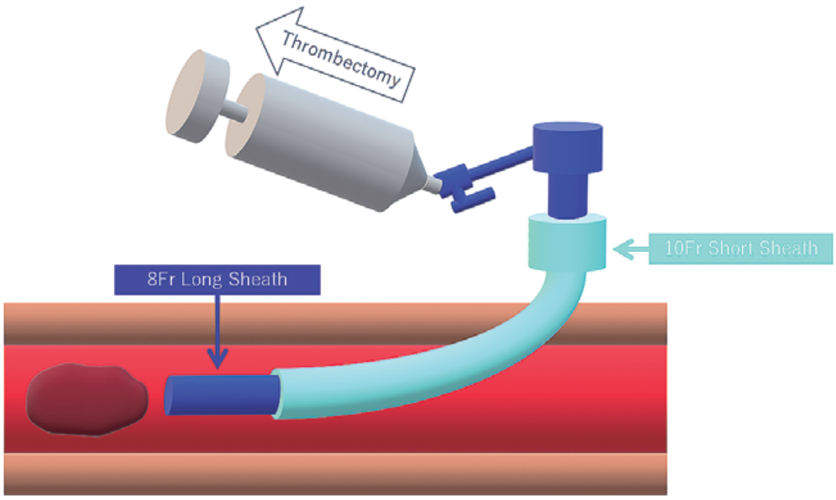

Fig. 2 Schema of the large-diameter system used for thrombectomy
Thrombectomy is performed by using an 8-Fr long sheath in a 10-Fr short sheath.

vascularization was preferable because of his lower limb pain. Surgical thrombectomy was not available at our institute. Five thousand units of unfractionated heparin was immediately administered at the start of the procedure. First, a 10-Fr × 11-cm sheath (Medikit Co. Ltd., Tokyo, Japan) was inserted in antegrade fashion into the left common femoral artery. Second, a 0.018-inch guide wire (Command; Abbott Cardiovascular, California, USA) was used to easily penetrate the occlusion site, and an 8-Fr × 45-cm sheath (Medikit Co. Ltd., Tokyo, Japan) was advanced along the guide wire through the 10-Fr sheath. Last, a 20-mL syringe was connected to the 8-Fr sheath after removal of the guide wire, and thrombectomy was repeatedly performed using manual aspiration (**Fig. 1B**). A large number of thrombi were successfully removed from the left SFA (**Fig. 1C**). Adjunctive balloon angioplasty (Coyote 2.0 / 220 mm; Boston Scientific, Marlborough, MA, USA) was then performed from the SFA to the posterior and anterior tibial arteries. The final angiogram showed good blood flow through the SFA, despite the presence of some small thrombi remaining in the distal left SFA. Hemostasis of the femoral 10-Fr sheath was successfully completed after endovascular treatment (EVT), using a suture-mediated closure device (Perclose Proglide; Abbott Vascular, Redwood City, CA, USA). Administration of 15,000 units/day of unfractionated heparin was immediately started after the procedure. At 12 days post-EVT, there was no evidence of thrombi on the angiogram (**Fig. 1D**) and the ABI of the left limb had improved from 0.57 to 0.93. Unfractionated heparin was replaced with warfarin on discharge.

Discussion

Treatment for ALI/SLI is decided in accordance with the Rutherford classification[3]. In patients with a viable limb (Rutherford class I), there is time to acquire noninvasive diagnostic imaging or noninvasive vascular studies. By contrast, patients with Rutherford class II limb ischemia require urgent revascularization, which is often amenable to EVT. Those presenting with a class IIb ischemia require emergent revascularization, traditionally achieved by open surgery. A recent case series, however, reported that EVT yielded similar revascularization rates, and lower morbidity and mortality rates, than open surgery[3–5]. Patients with irreversible limb ischemia (class III) may require amputation without attempted revascularization, as reperfusion abruptly releases toxic by-products of ischemic tissue into systemic circulation.

EVT for limb salvage can be performed by using CDT or mechanical thromboaspiration. CDT is recommended and widely performed for Rutherford class I/II ischemia[2]. Endovascular thrombectomy can serve as a complimentary or stand-alone technique for percutaneous revascularization that, ideally, hastens revascularization and limits the need for thrombolysis[6]. Percutaneous thrombus aspiration with a 6- to 8-Fr aspiration catheter was described as a feasible method of endovascular arterial thrombus extraction and has gained acceptance as a low-cost method offering quick recanalization, especially in infrainguinal arteries[4]. The method is quite simple: a stable end-hole catheter is delivered over a guidewire to the site of thrombus formation, after which a negative pressure syringe is used to aspirate blood and thrombus fragments. To our knowledge, the diameter of an 8-Fr aspiration catheter is equivalent to that of a 6-Fr sheath. In the present case, we applied this method using the larger catheter system of an 8-Fr sheath in a 10-Fr sheath, which achieved quicker and more effective thrombus aspiration (**Fig. 2**). In fact, a large number of thrombi were successfully and efficiently removed from the lesion. In the present case, thromboaspiration was performed with an 8-Fr long sheath. Use of a large-diameter guiding catheter would also be feasible. A 10-Fr guiding catheter has a diameter equal to that of an 8-Fr sheath and is as efficient as an 8-Fr sheath. Because a 10-Fr guiding catheter was not available at our hospital, we used an 8-Fr sheath in this case. In a retrospective study, Kwok et al. evaluated thrombolysis that used primary aspiration embolectomy[6]; technical success was achieved in approximately half the cohort by using primary aspiration alone. However, thrombectomy was performed with relatively small-diameter catheters in those previous studies[4,6]. Use of larger-diameter catheters or sheaths is likely far more efficient than using small-diameter lumen catheters. In addition, in our case, hemostasis of the puncture site was safely achieved with a suture-mediated closure device, despite the large diameter of the 10-Fr system used. In our experience, the suture-mediated closure device is feasible and safe for 10-Fr or smaller system. Larger systems require "pre-close" technique. This is one reason why we used a 10-Fr system in this case. The size of the system should be selected after considering the amount and location of the thrombus.

A potential risk of our procedure is a vessel injury due to the large-diameter sheath. However, such injuries can be prevented by advancing the guide wire and inner catheter when inserting the aspiration sheath to the lesion.

Several devices for percutaneous thrombectomy have been developed. The Rotarex device is equipped with a rotating screw at the tip of the catheter, to break the thrombus into fragments. The fragments are then aspirated into the catheter from the tip. Primary revascularization rates of 70% to 96% have been achieved, and the procedure is particularly useful for elderly patients with multiple medical comorbidities[7]. By comparison, the Angiojet Device uses a hydrodynamic aspiration mechanism. High-speed saline jets are injected through the catheter tip to create a Venturi effect, and the resulting low-pressure zone produces a vacuum effect that allows for simultaneous lysis and aspiration of the thrombus[8]. Our approach is far simpler than these methods and does not require special devices. It offers high cost-effectiveness and sufficient feasibility and safety—the most important factors for widespread use—regardless of the expertise of the institution and surgeon.

Conclusion

Our case report illustrates the feasibility, safety, and cost effectiveness of percutaneous thrombectomy performed with a large-diameter catheter system for treatment of ALI/SLI.

Conflict of Interest: The authors declare no conflicts of interest.

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(Received, May 5, 2020)
(Accepted, October 28, 2020)
(J-STAGE Advance Publication, November 30, 2020)