

Surgical treatment of symptomatic popliteal vein aneurysm with autologous saphenous vein panel graft

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ABSTRACT

We report a vein surgery procedure for popliteal venous aneurysms (PVAs). A 73-year-old woman with a long, irregularly shaped, PVA and thrombus underwent graft replacement using a manually made triple vein panel graft. Simple bypass grafting with a saphenous vein was unsuitable because of long defects and a size mismatch. We harvested the great saphenous vein from the right thigh, divided it into three segments, anastomosed it side-by-side on the long side, and created a venous panel graft. Good graft patency was confirmed at 4 years postoperatively, and the clinical course was stable without pulmonary embolism recurrence. (*J Vasc Surg Cases Innov Tech* 2021;7:645-8.)

Keywords: Aneurysm; Graft; Popliteal vein; Vascular surgical procedure; Venous thrombosis

Popliteal venous aneurysm (PVA) is one of the causes of pulmonary embolism (PE). As a thrombus supplier, it can result in repetitive and, even, fatal PE events.¹⁻⁵ Several case reports have reported successful surgical treatment,¹⁻³ and tangential aneurysmectomy was the most performed operation. However, some cases required other techniques because of the complicated shape of the PVA. The next most commonly performed procedure was vein replacement.³ However, the latter procedure has resulted in less favorable short- and long-term outcomes.^{3,5}

We have, thus, reported a surgical procedure for a case of PVA that had caused repetitive PE events and was treated by PVA resection and replacement using an autologous saphenous vein panel graft (ASVPG). The patient provided written informed consent for the report of her case details and imaging studies.

CASE REPORT

A 73-year-old woman was admitted to our outpatient clinic because of exertional dyspnea, and PVA and PE were diagnosed. Her medical history included hypertension. The left PVA with thrombosis was detected by echography, and PE was diagnosed by computed tomography (CT). She received subcutaneous injections of fondaparinux sodium for 5 days, followed by

30 mg of edoxaban (body weight, 57 kg). Although the thrombus had disappeared 3 months later, she was readmitted for PE recurrence with a large popliteal venous thrombus 6 months later despite still taking edoxaban. Although the edoxaban dose was increased to 60 mg, the thrombus did not resolve, and surgical treatment was indicated.

Two consecutive saccular aneurysms were observed above the level of the knee joint (Fig 1, A). The maximum diameter of the aneurysms was ~15 mm on echography (adjacent vein size, 4-5 mm in diameter, which was within normal limit) and 23 mm on CT (adjacent vein size, 7-8 mm). The whole length was 70 mm, with a 13-mm-diameter thrombus. Tangential aneurysmectomy and simple venous replacement with the great saphenous vein (GSV) were inappropriate, considering the defect length, the residual thrombus attached to the intima, and the size mismatch between the popliteal vein and GSV. Therefore, we created an ASVPG.

The patient was placed in the supine position under general anesthesia. The right GSV (length, 27 cm; $\phi = 3$ mm) was harvested endoscopically. The patient was turned to the prone position. The harvested vein graft was divided into three segments, each 9-cm long, and they were opened longitudinally (Fig 2). The long sides of these three segments were sutured side by side with 7-0 monofilament. Using a Hegar-type dilator, the diameter of the manually created graft was adjusted to 5.5 mm, which was 1 mm larger than that of the native popliteal vein.

The left popliteal vein was exposed via the posterior approach. The aneurysm was ligated proximally to prevent further thromboembolism during manipulation. The ASVPG was sutured with 6-0 monofilament sutures using end-to-end continuous anastomosis (Fig 3). After declamping the vein graft, the PVA was opened, and the thrombus and affected intima were resected. All inflow vessels to the PVA were ligated.

Unfractionated heparin was given at 3 hours postoperatively (target activated partial thromboplastin time, 2.0 times the control), and warfarin was administered from postoperative

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Author conflict of interest: none.

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The editors and reviewers of this article have no relevant financial relationships to disclose per the Journal policy that requires reviewers to decline review of any manuscript for which they may have a conflict of interest.

2468-4287

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<https://doi.org/10.1016/j.jvscit.2021.08.004>



Fig 1. A, Preoperative echogram showing two consecutive saccular aneurysms with thrombosis (*arrow*). **B,** Preoperative computed tomography showing a complex popliteal venous aneurysm with a large thrombus (*arrow*).

day 1 (target international normalized ratio, 1.5-2.0). A contrast-enhanced CT scan on postoperative day 7 showed patent graft flow and a small amount of exudate around the graft.

A follow-up CT scan at 1.5 months postoperatively revealed a residual fluid collection around the graft, and 140 mL of serous fluid was needle aspirated. We found no signs of infection. The 1-year follow-up CT scan showed a smooth graft shape, without any aneurysm, thrombus, or fluid collection (Fig 4, A). Anticoagulation therapy was switched from warfarin to edoxaban (30 mg). As a long-term result, the 4-year follow-up echography also showed smooth graft flow (Fig 4, B), and the patient was doing well without any leg-related symptoms.

DISCUSSION

The frequency of PVA has been reported to be rare (estimated at 0.2%-0.28%),^{1,2} and the definition of PVA has been controversial. A previous report suggested that the diameter of a fusiform PVA will be two times that of the normal popliteal vein and one that is three times greater is critical.⁵ According to previous studies, PE was observed in 39% to 71% of PVA cases.³⁻⁶ The use of only oral anticoagulation therapy is inadequate because of the high incidence of PE recurrence (80%), with some fatalities.⁵ Surgical repair should be considered for symptomatic patients with thromboembolic events, asymptomatic patients with an aneurysm diameter >20 mm, and patients with saccular or complex-shaped aneurysms.^{3,7} In the present patient, the PVA was dilated to three times the diameter of a normal vein and caused thrombosis repeatedly; hence, we planned surgery.

Several surgical techniques are available to treat PVA. The most common procedure is tangential aneurysmectomy,

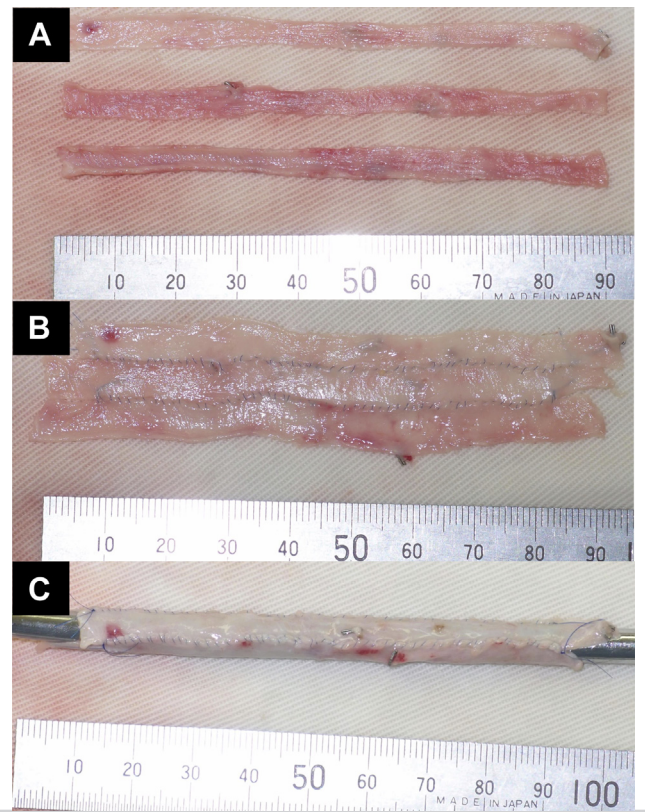


Fig 2. A, The right great saphenous vein (length, 27 cm; $\phi = 3$ mm) was harvested endoscopically with the patient in the supine position. It was divided into three segments, each 9-cm long, and opened longitudinally on a side table. **B,** The long sides of these three segments were sutured side by side with 7-0 Prolene continuous sutures (Ethicon, Johnson & Johnson, Raritan, NJ). **C,** The diameter of the manually created graft was adjusted to a Hegar-type dilator that had a diameter of 5.5 mm (1 mm larger than the native popliteal vein).

performed in 62% to 78% of cases.^{3,5} This technique is preferred because of its simplicity and low complication rate.^{3,5} However, the affected intima can be incompletely resected, and the residual aneurysmal wall will likely cause recurrent thrombus.⁷ In the present patient, the PVA's morphology was complicated, and the thrombus was adherent to the aneurysm wall. Therefore, simple tangential aneurysmectomy was considered insufficient. When tangential aneurysmectomy is not suitable, complete aneurysm resection with venous reconstruction should be performed.⁵ However, the calibers of the native popliteal vein and autologous GSV might not be compatible. This discrepancy can cause graft obstruction or recurrent thrombosis.

To resolve these problems, we applied the ASVPG concept.⁸ Some similar concepts have been reported with good mid-term durability, including the ASVPG and spiral graft.^{8,9} However, data on the long-term durability of the ASVPG for PVA have not been reported. We believe the ASVPG must have several factors resolved

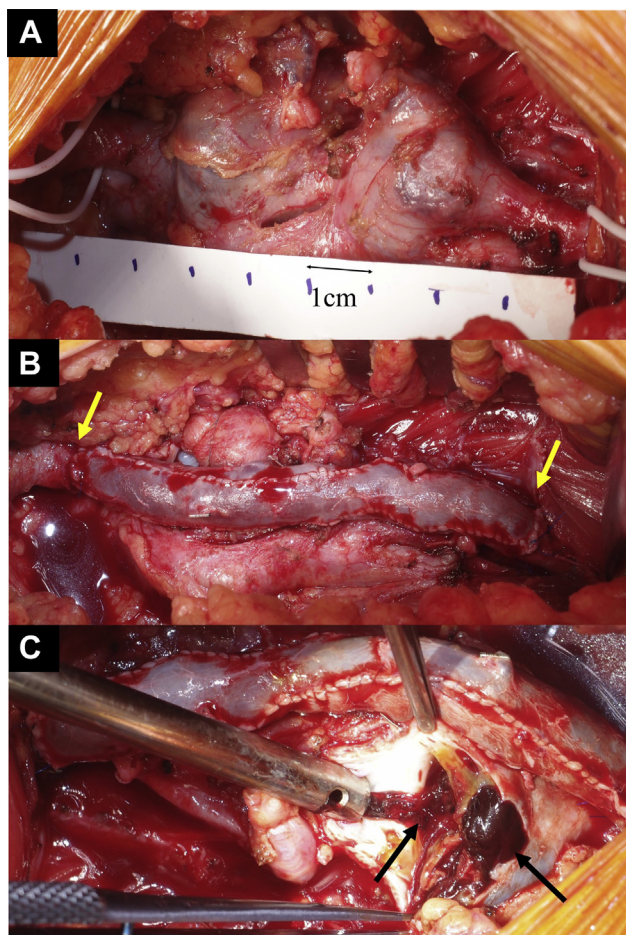


Fig 3. **A**, Intraoperative photograph showing complex-shaped and sacular, long-segment popliteal venous aneurysms (PVAs) with thrombosis. Dots on the paper were marked every centimeter. The proximal and distal sides of the PVAs were taped with rubber threads. **B**, The manually created vein graft was sutured with 6-0 Prolene using end-to-end continuous anastomosis (arrow). **C**, Many thromboses had adhered to the diseased aneurysmal intima (arrow).

before it can be used. At first, the spiral suture line will make more turbulence in venous flow than will the longitudinal panel suture line. Second, it could be more difficult to design the conduit. Finally, a stump line of the spiral version cannot, theoretically, be horizontal. This can cause turbulence at the anastomosis.

We altered the native GSV to create a wider autologous vein graft (Fig 2). The diameter of our graft was adjusted to 1 mm larger than the native popliteal vein as measured by echography using a Hegar-type dilator. The number of panels was roughly calculated from the circumference, and we made fine adjustments in the suture depth. Autologous veins are more resistant to infection and thrombosis than are artificial grafts, and an adjusted wide diameter can provide laminar flow, which leads to prolonged patency. Harvesting the ipsilateral

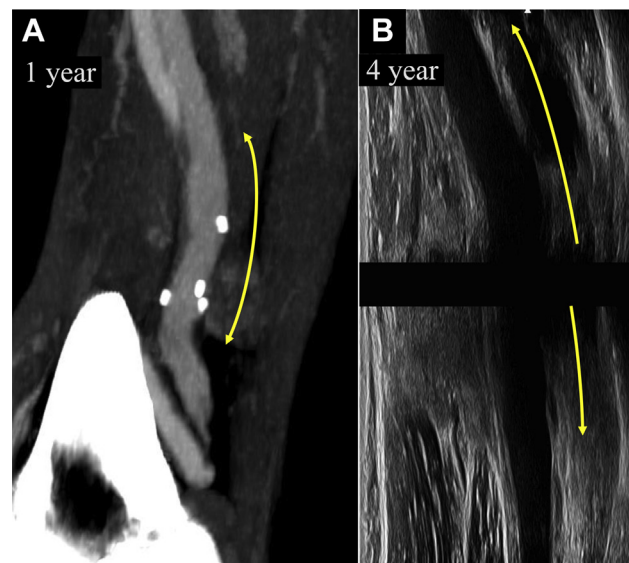


Fig 4. **A**, Postoperative computed tomography scan 1 year postoperatively. The graft wall was smooth, and no thrombosis or aneurysm was present. The enhanced small points around the vein were clip devices. Arrows indicate an approximate substituted range. **B**, Postoperative echography 4 years postoperatively showing a smooth graft wall and good flow. Arrows indicate an approximate substituted range.

saphenous vein should be avoided because of the risk of losing an escape route in the event of thrombosis at the reconstructed site.⁵

One disadvantage of this technique is the increased risk of bleeding or fluid collection around the graft owing to the use of more suture lines. In the present patient, serous exudate was drained at 1.5 months after the procedure. However, these complications were more permissive than thromboembolism. The long patency was confirmed by echography at 4 years postoperatively.

In most previous cases, postoperative anticoagulation management with warfarin was administered for 3 to 6 months.^{1,10} Because the long-term results of this graft arrangement were unclear, warfarin treatment was continued for 1 year and then the patient was switched to a low-dose direct oral anticoagulant. In the present case, edoxaban (30 mg) was administered. No embolic events were reported, and echography at 4 years postoperatively showed a smooth graft wall and good flow.

CONCLUSIONS

We have reported a complicated shape PVA case with thrombus and recurrent PE even after direct oral anticoagulant medication. An ASVPG was applied to resect and replace the PVA. This conduit has been patent and in good shape for >4 years. This procedure can be quite effective for these complicated PVAs, although our findings require confirmation by studies with much longer follow-up and a greater number of patients.

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Submitted May 21, 2021; accepted Aug 15, 2021.