The sheathless ultrafine laser ablation technique for managing deep muscle branch reflux in hostile anatomy following rhabdomyosarcoma resection

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ABSTRACT

A 45-year-old woman presented with a venous aneurysm in the popliteal fossa and leg heaviness 26 years after rhabdomyosarcoma resection. Standard endovenous ablation was unfeasible because the target deep muscle branch was too short (1.5 cm) for a standard introducer sheath. We used a sheathless ultrafine laser ablation technique: a 400-μm fiber passes directly through an 18G catheter, eliminating the need for a sheath. Using a segmental pulse protocol (7 W), the vessel was successfully ablated. Three-month ultrasound examination confirmed complete occlusion without complications. This technique offers a geometric solution for treating short perforators where standard sheaths cannot be deployed. (J Vasc Surg Cases Innov Tech 2026;12:102274.)

Keywords: Endovenous laser ablation; Perforator; Sheathless technique; Venous aneurysm; Varicose veins

Varicose veins secondary to extensive soft tissue surgery or trauma present a unique therapeutic challenge. Unlike primary truncal reflux, these lesions often originate from incompetent deep muscle branches or perforators that have dilated due to anatomical disruption after muscle resection. Standard endovenous laser ablation requires a 5F or 6F introducer sheath, whose minimum insertion depth (dead space) makes treating short venous segments (<2 cm) geometrically impossible.[1]

Written informed consent was obtained from the patient for publication.

To address this limitation, we used a modified approach with a 400-μm ultrafine fiber. This fiber passes directly through a standard 18G peripheral intravenous catheter, eliminating the need for a sheath. We term this the sheathless ultrafine laser ablation (UFLA) technique. We describe its application for a short, deep muscle branch in a patient with secondary varicosities after resection for rhabdomyosarcoma.

CASE REPORT

A 45-year-old woman presented with left leg heaviness and swelling (Clinical Etiological Anatomical Pathophysiological class C3). Physical examination revealed a tender, palpable venous aneurysm (11 × 13 mm) in the popliteal fossa (Fig 1, *A*). The patient reported progressive enlargement and increasing pain over the preceding year, and the lesion had become firm on palpation, consistent with partial thrombosis. Tortuous varicosities extended along the lateral calf (Fig 1, *B*). At the 3-month follow-up, the varicosities had resolved and the branch aneurysm demonstrated complete thrombosis with no residual flow on duplex ultrasound examination (Figs 1, *C, D*). Her medical history was notable for rhabdomyosarcoma of the left leg, treated with wide resection and radiotherapy 26 years prior. She subsequently developed cellulitis in the affected limb.

Duplex ultrasound examination (LOGIQ; GE Healthcare) demonstrated competent great and small saphenous veins. The primary source of reflux was identified as a deep muscle branch (diameter of 2 mm) located within the scar tissue of the previous tumor resection. The surrounding subcutaneous tissue was dense and fibrotic.

TECHNIQUE

The procedure was performed under local anesthesia with the patient in the prone position.

First, under ultrasound guidance, the target muscle branch was cannulated using a standard 18G peripheral intravenous catheter (Supplementary Video). This vessel was extremely short (1.5 cm long) and connected directly to a large, partially thrombosed branch aneurysm at the fascial level (Fig 2, *A*). Compared with the standard 600-μm fiber, which requires at least a 16G catheter, the 400-μm system reduces perforation risk and facilitates cannulation of short, tortuous targets.

Second, the needle stylet was removed, leaving only the short plastic cannula. A 400-μm radial optical fiber (BA400 R; WONTECH) was introduced directly through the angiocath lumen into the vein (Fig 2, *B*). The fiber passed freely through the catheter lumen. The fiber was connected to a 1470-nm diode laser system (Veincare; WONTECH).

From the Good Leg Clinic.

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Fig 1. Clinical presentation and postoperative outcome. **(A)** Preoperative posterior view. A prominent venous aneurysm (*arrow*) is visible in the left popliteal fossa. **(B)** Preoperative lateral view. Tortuous varicosities extending along the lateral calf (*arrow*). **(C)** Three-month postoperative posterior view. Complete resolution of the aneurysm and normalization of the leg contour. **(D)** Three-month postoperative lateral view. Disappearance of the lateral varicosities with no residual pigmentation.

Third, ultrasound-guided tumescent anesthesia was infiltrated into the perivenous space surrounding the target perforator. The tumescent solution consisted of 1000 mL of 0.9% normal saline, 20 mL of 2% lidocaine, 1 mL of 1:1000 epinephrine, and 20 mL of 7% sodium bicarbonate. Due to the short treatment zone, a continuous pullback was deemed unsafe. Instead, we used a segmental pulse protocol: Power set at 7 Watts, with 1-second pulse duration. The fiber was withdrawn in 2-mm increments between pulses (stop-and-shoot). This strategy allowed real-time ultrasound verification of the fiber tip position before each emission, ensuring energy was delivered strictly to the endothelium without injuring the deep venous system.

The remaining superficial varicose veins were treated in the same session using the same 1470-nm laser system and 400-μm fiber (6 W) combined with ambulatory phlebectomy, addressing both the reflux source and its downstream manifestations.

RESULTS

The procedure was completed in 60 minutes with minimal pain (visual analog scale, 1-2). No paresthesia or skin burns occurred. Clinically, at the 3-month follow-up, the patient reported resolution of symptoms, and physical examination showed disappearance of the popliteal bulge and lateral varicosities. Follow-up duplex ultrasound examination confirmed complete occlusion of the muscle branch (Fig 2, *C*) and thrombosis of the aneurysm (Fig 2, *D*).

DISCUSSION

Treating refluxing deep muscle branches is inherently challenging due to their anatomical depth and proximity to neurovascular bundles, compounded in this case by the patient's history of resection for rhabdomyosarcoma. Although the incompetent muscle branch measured only 2 mm at its origin, it dilated to 5 mm near the aneurysm. The patient's symptoms developed only after tumor resection and subsequent

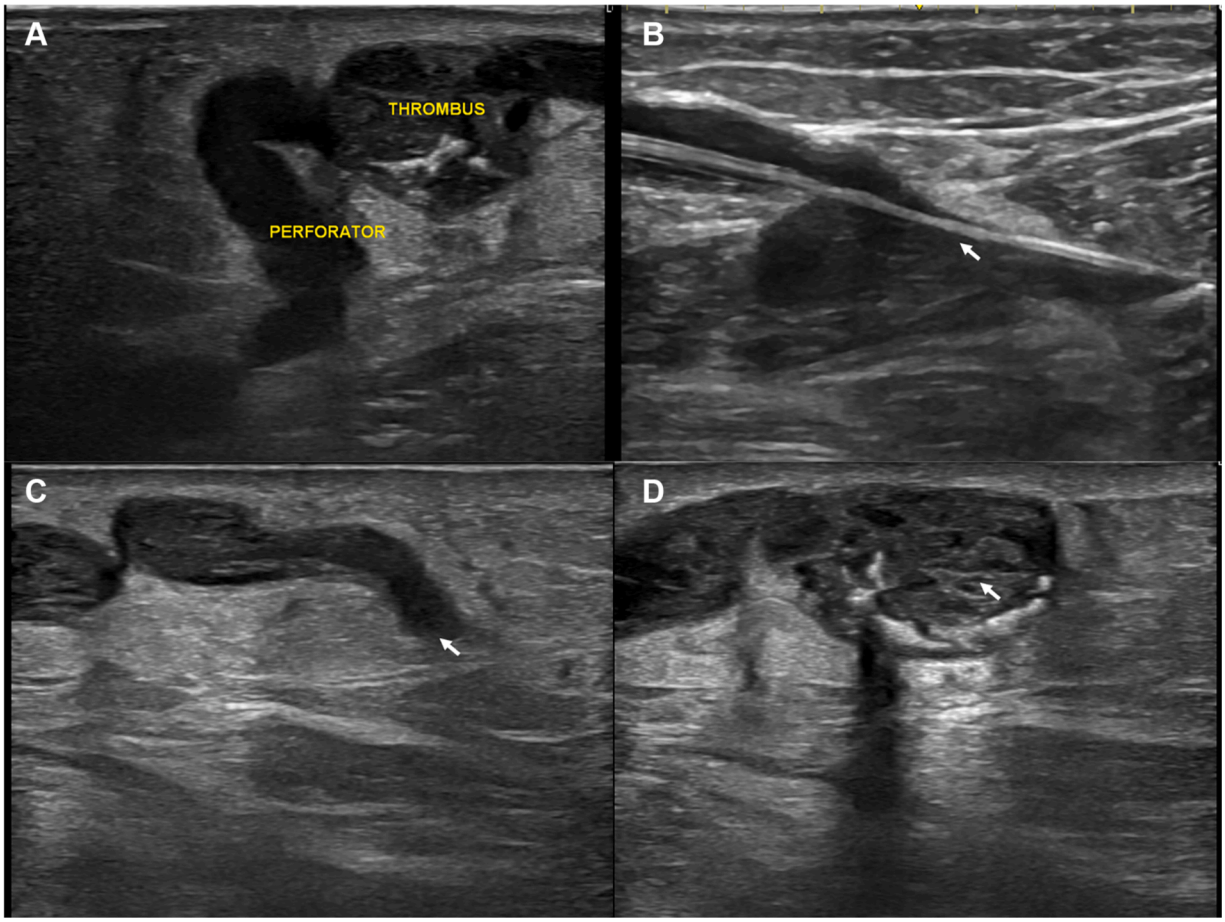

Fig 2. Duplex ultrasound findings and procedural technique. **(A)** Preoperative assessment. A prominent incompetent deep muscle branch (*PERFORATOR*) connects to a large, partially thrombosed venous aneurysm (*THROMBUS*). **(B)** Intraoperative technique. Longitudinal view showing the 400-μm radial laser fiber (*arrow*) advancing directly through the 18G catheter without an introducer sheath. **(C)** Three-month follow-up (perforator). The target deep muscle branch has transformed into a hyperechoic fibrotic cord (*arrow*), indicating complete occlusion. **(D)** Three-month follow-up (aneurysm). The venous aneurysm shows complete regression and thrombosis (*arrow*) with no detectable flow.

wound infection, localizing the pathology to the surgical field. Although a definitive causal relationship cannot be established, targeted ablation of this single source of reflux resulted in clinical improvement and symptom resolution at the 3-month follow-up. Nonthermal alternatives were deemed suboptimal: foam sclerotherapy risked deep vein thrombosis due to high-flow washout, whereas cyanoacrylate closure risked glue migration given the extremely short target vessel (1.5 cm).

The primary innovation in this report is the recognition that standard sheaths are geometrically unsuitable for short venous segments: their 1- to 2-cm insertion depth either occludes the entire segment or causes the sheath to lose purchase. The UFLA technique resolves this by using the 400-μm fiber through an 18G angiocath as the sole access device (Fig 3), eliminating the sheath's footprint and enabling ablation in veins as short as 1 cm.

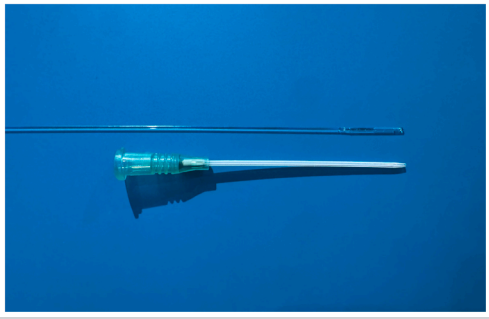

Fig 3. Size comparison of the 400-μm radial optical fiber and an 18G peripheral intravenous catheter. The ultrafine 400-μm radial optical fiber (BA400 R; WONTECH) is shown alongside a standard 18G peripheral intravenous catheter for scale. The fiber's diminutive diameter permits direct passage through the catheter lumen, eliminating the need for an introducer sheath and enabling access to small-caliber vessels in anatomically challenging locations.

Prior studies of transluminal perforator ablation, such as the transluminal occlusion of perforator technique, used dedicated radiofrequency or laser devices with rigid needle access.[2,3] Our UFLA approach offers several practical advantages. First, it requires no specialized equipment: a standard 1470-nm EVLA system with a 400-μm fiber and an 18G soft intravenous catheter can be readily extended from truncal vein ablation to the treatment of perforators, small branches, and deep muscle branches. Second, the soft cannula provides greater maneuverability in angulated or tortuous vessels compared with rigid needle puncture. Third, the sheathless design accommodates extremely short treatment segments. To our knowledge, this report is the first of transluminal endovenous ablation applied to a deep muscle branch.

This technique is not without limitations. First, this is a single case report with only 3 months of follow-up; longer-term outcomes and broader applicability remain to be established. Second, the approach relies on catheter stability within the target vessel. If the vessel is too short or tortuous for secure fixation, the quartz fiber's limited flexibility may risk fracture or vessel injury, causing off-target thermal damage or incomplete ablation. Continuous ultrasound visualization of the fiber tip is mandatory; the procedure should not be attempted if the fiber cannot be identified within the lumen. Finally, comprehensive duplex ultrasound evaluation must confirm that truncal veins are competent and that the target branch is the primary source of reflux before intervention. Perforators and deep muscle branches are normal anatomical structures; ablation is warranted only when they are demonstrably incompetent and responsible for the patient's symptoms.

CONCLUSIONS

The sheathless UFLA technique offers a practical and safe solution for ablating short, refluxing deep muscle branches. By enabling sheathless access via a 400-μm fiber and an 18G needle, it expands the endovascular repertoire for complex secondary varicosities where standard sheaths cannot be deployed.

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DISCLOSURES

None.

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