

Arteriovenous Fistula Complicated by Popliteal Venous Access for Endovascular Thrombolytic Therapy of Deep Vein Thrombosis¹

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We report a case of an iatrogenic arteriovenous fistula complicated by catheter-directed thrombolytic therapy in a patient with acute deep vein thrombosis of a lower extremity. To the best of our knowledge, this is the first report of an arteriovenous fistula between the sural artery and popliteal vein in that situation. As the vessels have a close anatomical relationship, the arteriovenous fistula seems to be a potential complication after endovascular thrombolytic therapy of acute deep vein thrombosis.

Index words : Venous thrombosis
Arteriovenous fistula
Popliteal vein
Catheterization

Recently, catheter-directed local thrombolysis has been widely accepted as an effective method to treat acute deep vein thrombosis of the lower extremities (1 - 3). Vascular access through the popliteal vein is the most common route for the procedure. To date, procedure-related complications such as hemorrhaging, pulmonary embolism, infection and, sepsis have been reported. However, to our knowledge, iatrogenic arteriovenous fistulas have not been reported to date (4).

We experienced a case of an arteriovenous fistula between the sural artery and popliteal vein and report it as one of the potential complications after endovascular thrombolytic therapy of acute deep vein thrombosis.

Case Report

A 52-year-old woman presented with bilateral lower extremity varicose veins. A Doppler ultrasonography revealed reflux in the great saphenous and perforating veins of the calves, which is an indicator of venous insufficiency. In addition, no deep vein thrombosis was observed. Ligation and electrocauterization of the great saphenous and perforating veins was performed under general anesthesia with no immediate postoperative complications.

Five days after surgery, the patient experienced pain in the left thigh and edema of the lower extremities, indicating a suspected case of deep vein thrombosis. A Doppler ultrasonography found that the left common femoral, superficial femoral, and popliteal veins were not compressed. It also revealed that the lumen was expanded and filled with thrombus, which led to the diagnosis of deep vein thrombosis. A CT angiography was performed to identify the extent of the thrombus. The venous phase revealed low density thrombi of the common iliac and external iliac veins, as well as a floating

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thrombus in the infrarenal inferior vena cava. Consequently, a retrievable filter (Optease retrievable vena cava filter, Cordis, Miami, U.S.A.) was inserted. The catheter-directed local thrombolysis was scheduled for the treatment of deep vein thrombosis. After placing the patient in the prone position, the popliteal region was prepared. Next, the posterior wall of the popliteal vein was punctured with a 21G microneedle (Micropuncture introducer set, Cook, Bloomington, U.S.A.) using a 0.018-inch guidewire (Micropuncture introducer set, Cook, Bloomington, U.S.A.), to avoid puncturing the popliteal artery. After a 6-F sidearm sheath (Radiofocus, Terumo Corporation, Tokyo, Japan) was inserted, an 11 cm infusion catheter (multi-sideport catheter infusion set, Cook, Bloomington, U.S.A.) was positioned in the thrombus and 1.6 million IU of urokinase was administered at a rate of 100,000 IU/hour. An ascending venography performed 16 hours later showed an almost complete eradication of the left superficial femoral and popliteal veins. However, thrombus was still present in the left external iliac vein. Moreover, the left common iliac vein was strictured, causing insufficient circulation. The sheath was exchanged for a 10-F long sheath, followed by performing an aspiration thrombectomy, a procedure in which the thrombus is eradicated by using negative pressure created by a 50 cc syringe, was performed after inserting a 8-F Hoffman sheath (Cook, Bloomington, U.S.A.).

An angioplasty was performed by inserting a 14 mm × 8 cm metallic stent (Wallstent Endoprosthesis, Boston Scientific, Galway, Ireland) in the left common iliac vein using a 14 mm × 2 cm balloon catheter (ATB advance, Cook, Bloomington, U.S.A.), and an inflator (Inflator, Guidant, Indianapolis, U.S.A.). A follow-up ascending venography revealed a complete eradication of the thrombus and no problems with circulation. As a result the procedure was terminated.

The patient was discharged without any symptoms, but thrills were palpated in follow-up examinations. In the arterial phase of a follow-up CT angiography, the left popliteal, femoral, and iliac veins appeared to have the same density as the arteries, thus suggesting the development of an arteriovenous fistula (Fig. 1). A Doppler ultrasonography revealed intravenous arterial blood flow superior to the popliteal vein; however, a definite fistular tract could not be found. The CT angiographic images obtained before and after surgery were compared retrospectively. A sural artery was found to be wrapped externally around the popliteal vein (Fig. 2A).

The postoperative images showed that the left sural artery had thickened, which was substantiated by the fact that contrast fluid was leaking into the popliteal vein. As a result, we concluded that the arteriovenous fistula had occurred between the sural artery and popliteal vein (Fig. 2B). A procedure was performed to treat the arteriovenous fistula. When the popliteal vein was exposed, a small artery was connected to the popliteal vein in the posterolateral direction of the popliteal vein. This was judged to be the arteriovenous fistula and was subsequently ligated. A Doppler ultrasonography performed in the operative field showed no arterial wave forms in the veins and the thrills were no longer palpated. The patient was discharged following the operation and has had no arteriovenous fistula recurrence.

Discussion

In treating acute deep vein thrombosis of the lower extremities, we found that a catheter-directed local thrombolysis rapidly eliminates more thrombus than current conventional treatments including leg elevation, wearing an elastic stocking, conventional anticoagulation, and whole body thrombolysis. Catheter-directed local thrombolysis also allows the patient's circulation to recover. In addition, it eliminates the pain and edema as well as maintains the valvular function of the veins which could prevent post-thrombotic syndrome. Performing a catheter-directed local thrombolysis can also normalize local stenosis and obstruction by insert-



Fig. 1. An axial image of the contrast-enhanced CT angiography in the arterial phase showed strong enhancement of left common femoral vein (arrow). This was consistent with the arteriovenous fistula and was comparable with the contralateral common femoral vein.

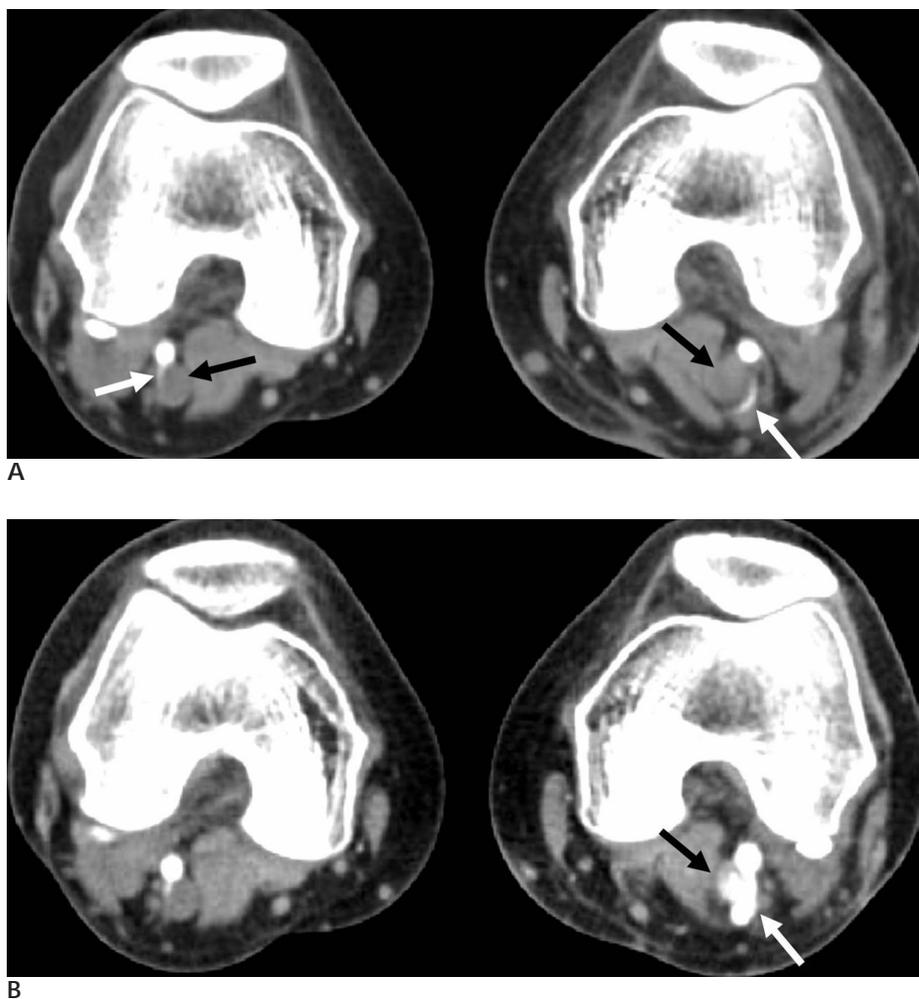


Fig. 2. Axial images of contrast-enhanced CT angiography in the arterial phase before (A) and after (B) a retrospective review of endovascular thrombolytic therapy of acute deep vein thrombosis. For this patient, the sural arteries (white arrows) arose from the popliteal arteries and ran wrapping around the popliteal veins (black arrows) posterolaterally. Following treatment, the left sural artery revealed a greater degree of dilation. In addition, contrast leakage from the left sural artery into left popliteal vein was noted.

ing a stent. Therefore, it is recognized as the most effective treatment (1 - 3).

The access route differs according to the extent and location of the thrombus; however, the ipsilateral popliteal vein of the lesion is most commonly used. This is because the lesions are easily approached via the guidance of US and the instruments can easily pass through the direction of the valve, which makes thrombolysis, angioplasty, and the insertion of stents possible. This is especially useful in patients with iliofemoral vein thrombosis (1, 2).

The most common complication of this procedure is bleeding. Local bleeding in the region of access and bleeding in remote regions such as the intracranium, retroperitoneum, gastrointestinal system, musculoskeletal system, and genitourinary system have been reported. Bleeding that requires transfusion occurred in approximately 5 - 10% of cases and primarily occurs at the puncture site (1, 2). Minor bleeding that doesn't require special treatment has been reported in 16% of cases and intracranial bleeding occurred in 0.2 - 0.4% (1 - 3).

Bjarnason et al. (5) reported that the rate of pulmonary embolisms was 1%; however, according to The National Venous Registry (6), fatal pulmonary embolisms occurred in only one patient out of 422. Further, it is known that death due to catheter-directed local thrombolysis is rare. Other complications related to the procedure include infection and sepsis (1, 2).

There are no known reported cases for the development of an arteriovenous fistula following catheter-directed thrombolysis in the popliteal fossa as in this current case study. In a study on the anatomical relations of the popliteal artery and vein by Trigaux et al. (7), the popliteal artery was located anterior to the popliteal vein in 92% of cases, Moreover, more than 25% of the diameter of the popliteal artery was overlapped by the popliteal vein in 87% of cases. Further, the authors documented that when the popliteal artery was punctured percutaneously from the posterior, the needle passes the popliteal vein, and caution is required because there is a possibility for the formation of an arteriovenous fistula. However, unlike the iatrogenic arteriovenous fistula

that occurs in 1 - 5% after intervention through the femoral artery, complications are relatively rare in the popliteal fossa (4, 8). This is probably because iatrogenic arteriovenous fistulas rarely occur when only the posterior wall of the popliteal vein is punctured for catheter-directed thrombolysis, while the patient is put into a prone position due to the anatomical relations of the popliteal artery and vein. Also, the intervention through the popliteal artery or vein was performed less frequently than the intervention through the femoral artery or vein and was not as aggressive, contributing to relatively less development of complications. However, as the catheter-directed local thrombolysis is standardized as the treatment of deep vein thrombosis in the lower extremities, more procedures are expected to be performed. As a result, the sural artery, which is a small branch of the popliteal artery, can potentially be a hazard to develop into an arteriovenous fistula. Thus, more studies are required to assess the anatomical relationship between the anatomical relations of the sural artery and popliteal vein.

The sural artery branches, from the popliteal artery into the medial and lateral branch at the level of the knee joint, supply the gastrocnemius, soleus, and plantaris muscles and have branches of various sizes that run parallel to the small saphenous vein and supplies the superficial tissues (9). Timperman et al. (10) reported the occurrence of an arteriovenous fistula between the superficial sural artery and small saphenous vein after intravenous laser treatment in patients with lower extremity varicose veins due to the insufficiency of the small saphenous vein. They assumed this as a possible complication based on the fact that the superficial sural artery is located medially and posteriorly to the small saphenous vein, and that they run together in 91% of cases. As well, they insisted that the development of a fistula should be evaluated after the procedure by color ultrasonography. In this case, the CT angiography showed that the lateral sural artery branched from the popliteal artery, passed the popliteal vein, and wrapped itself around it. This kind of anatomical relationship is thought to be the cause of an arteriovenous fistula.

The sural artery in the popliteal fossa is so small that it

cannot be easily detected on gray scale ultrasonography. In our opinion, careful color-coded duplex ultrasonography with positioning of the color box around saphenopopliteal junction, popliteal vein, and small saphenous vein, could help find the sural artery in the popliteal fossa.

In conclusion, we reported a case of an arteriovenous fistula in the popliteal fossa, between the popliteal vein and sural artery, after a catheter-directed local thrombolysis. The anatomical relations of the sural artery and popliteal vein should be considered when the popliteal vein is punctured under US guidance. Also, the possibility of an arteriovenous fistula should be recognized and proper management should be taken.

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