Delayed Venous Stent Migration Presenting as Pulmonary Embolism and Managed With Retrieval Using a Snare and Ultrasound-Enhanced Catheter-Directed Thrombolysis

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ABSTRACT: A 37-year-old female with history of multiple deep venous thromboses, status post temporary inferior vena cava filter placement and removal, and stent deployment to right popliteal vein, presented with progressively worsening shortness of breath and right leg swelling. Upon admission, the patient was found to have had pulmonary embolism with delayed venous stent migration to the right pulmonary artery greater than 1 year following initial stent implantation. Stent retrieval was performed using a snare device and residual clot burden was managed using ultrasound-accelerated catheter-directed thrombolysis with significant improvement.

CASE PRESENTATION
A 37-year-old female with history of multiple deep venous thromboses (DVT) presented with progressively worsening shortness of breath and right leg swelling. Recurrent DVT was attributed to factor V Leiden deficiency and cervical adenocarcinoma, status post temporary inferior vena cava (IVC) filter placement upon initial diagnosis 3 years prior to current presentation and filter removal 6 months later. Right popliteal vein compression was also noted during initial DVT presentation, which was treated with balloon angioplasty and subsequently stent deployment during recurrence 2 years later with a Supera 7 mm x 100 mm self-expanding stent (Abbott). The patient was undergoing comprehensive decongestive therapy and manual lymphatic drainage for 6 months prior to treat her chronic lymphedema from longstanding venous insufficiency. Upon admission, chest x-ray was performed that showed a metallic stent overlying the right lower lobe (Figure 1). Chest CT confirmed pulmonary embolism (PE) with venous stent migration to the right pulmonary artery (PA) (Figure 2).

Access was obtained in the right femoral vein, and
iliocaval venogram revealed brisk flow with no evidence of thrombosis and normal caliber iliac veins. A balloon-tipped PA catheter was used to demonstrate elevated right heart pressures with PA mean pressure of 35 mmHg. Angiogram of the PA confirmed the presence of a stent lodged in the right lower lobe branch of the PA (Figure 3). A 7 Fr Pinnacle Destination sheath (Terumo) was then advanced selectively into the right PA, and a 25 mm Gooseneck snare (Covidien) was used to capture the embolized stent edge (Figure 4a). Persistent negative backward pressure on the snare with concurrent positive forward pressure on the sheath was utilized to gradually retrieve the embolized stent into the sheath (Figure 4b) and subsequently externalized from the sheath (Figure 5). Repeat selective PA angiogram revealed persistent clot burden in the right lower lobe branch of the PA (Figure 6). An ultrasound-enhanced thrombolysis catheter (EkoSonic Endovascular System; BTG International) was positioned within the right lower lobe branch of the PA and catheter-directed thrombolysis (CDT) initiated at 1 mg/hr of tPA infusion through the catheter (Figure 7). The thrombolysis catheter was removed after 24 hours and the patient subsequently initiated on anticoagulation with warfarin and discharged home when therapeutic levels had been reached. She was seen in follow-up in 1 month when a repeat CT revealed resolution of the pulmo-
nary embolism (Figure 8) and no residual injury from the embolized stent.

**DISCUSSION**

Endovascular stenting for occlusive venous disease has become a more frequent undertaking recently. Stent migration is a feared complication of these procedures. The reported rate of stent migration is less than 3%.\(^1\)\(^2\) However, the true incidence of stent migration is believed to be much higher than what is reported in the literature. Besides the risk of thrombotic events, dislocated stents are associated with permanent traumatic injury to the vascular wall with subsequent threat of perforation.\(^3\) In addition, several cases of venous stent dislodgement have been shown with and without injury to the tricuspid valve.\(^4\)\(^6\) Incidence of migration of stents from the
Peripheral venous system is not known. Migration of stents to the heart and PA from the superior vena cava has been reported.\(^7,8\) Additionally, the incidence of delayed stent migration over an extended period of time has not been significantly reported. One case in particular details delayed migration of a venous stent to the right atrium over 3 years with deep tissue massage as the primary mechanism of migration.\(^9\) Another case study describes migration of an external iliac artery stent to the common iliac artery after 1 month.\(^10\)

It appears in most cases of stent migration that inappropriate stent dimensions and malposition may be major contributing factors. Several techniques have been used in the retrieval of embolized stents. Initially, use of a basket or self-made wire snares were primary modalities.\(^11\) Baskets are useful when one end of a foreign object is free in the vessel lumen. Entrapment using a basket is difficult in tortuous or angulated vessels.\(^12\) The forceps technique has also been used but often requires a venous cut-down and is potentially traumatic, causing lacerations and perforations.\(^13\) Balloon catheters have also been used to capture the stent and reposition it in an alternate vascular segment. In one of the largest single-center trials investigating retrieval of migrated stents, balloon catheters were the predominant method used with the greatest success.\(^14\) However, with self-expanding stents, this is less successful because of the tendency of the stent to assume the nominal diameter in the vascular lumen.\(^15\)

The nitinol stent is unable to expand beyond its nominal diameter, has a high degree of self-expandability, and has a larger mesh size; all of these characteristics make retrieval of such stents difficult. Use of a nitinol snare has become the method of choice for stent removal.\(^16\) Capturing and compressing the stent often damages the stent, and unprotected passage may damage the vessel wall; therefore, use of a larger overlying catheter with the snare allows better control of the snare and atraumatic withdrawal of the stent.\(^13\) Significant success has been found in
the use of snares for foreign body retrieval in a number of single-center trials and cases. The use of a snare enhances torque control, improves grasping capacity, allows visualization with fluoroscopy due to radio-opacity, limits traumatic effect, and is available in various sizes for differing vascular beds.

Percutaneous CDT of thromboembolic occlusions in native arteries and veins has become an important adjunctive treatment strategy because of its less invasive nature and ability to more completely remove thrombus. The STILE and TOPAS trials compared CDT and surgical thrombectomy in arterial thrombosis and revealed no difference in limb salvage or death between the groups. The goal of ultrasound-mediated CDT is to reduce therapy time and thereby minimize hemorrhagic complications. Ultrasound-accelerated CDT uses advanced ultrasound excitation to precondition blood clots for rapid thrombolysis. Ultrasound-accelerated CDT has been shown to be an effective treatment modality in patients throughout the venous and arterial systems. When compared with CDT, this treatment modality provides similar treatment efficacy with reduced thrombolytic infusion time and treatment-related complications.

Several cases demonstrating reduction of clot burden and resolution of symptoms in massive and submassive pulmonary emboli have been published in the literature. Recent clinical trials have further established the benefit of ultrasound-guided CDT in right ventricular enlargement and overall adverse outcomes in PE. We describe herein a rare case of delayed stent migration from right popliteal vein to the right PA resulting in PE that was successfully managed using snare retrieval and ultrasound-enhanced CDT.

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