Successful Wallstent exclusion of iliofemoral venous aneurysms—a new treatment paradigm

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ABSTRACT

Treatment of venous aneurysms involving the iliac and femoral veins has generally been an open surgical approach, with a few case reports noting use of an endovascular approach. We report three cases: (1) a patient with an iliocaval occlusion involving an occluded TrapEase filter who presented with a large left external iliac vein aneurysm; (2) a patient with a left common femoral vein aneurysm; and (3) a patient with left profunda femoris vein aneurysms with associated pulmonary embolism. All three patients were successfully managed with the use of appropriately sized bare metal woven stents (Wallstents; Boston Scientific). Their clinical presentation, technical considerations, and outcomes are reviewed. (J Vasc Surg Cases Innov Tech 2023;9:101304.)

Keywords: Endovascular stenting; Iliac vein aneurysm; Wallstent; Woven venous stent; Venous aneurysms

Venous aneurysms are rare, with the lower extremities and pelvis reported as the most common sites.[1-3] Slightly more than 50 aneurysms of the iliac veins have been reported.[4-6] However, significantly fewer aneurysms involving the femoral veins can be found in the literature.[1,7-19] Although venous aneurysms in the lower extremities result in the risk of pulmonary embolism, pelvic venous aneurysms have an additional risk of rupture.[1,2,4] This brings up the issue of treatment, which for venous aneurysms involving the iliac and femoral veins is generally open surgical repair, usually with tangential aneurysmectomy and lateral venorrhaphy or a variation.[4] A few cases have been reported of the use of covered stent grafts,[20] coil embolization,[21,22] a hybrid approach,[23] and coil embolization with open cell nitinol stents.[10] To the best of our knowledge, no studies have reported the exclusive use of uncovered or bare metal stents (eg, Wallstents; Boston Scientific). We report the successful exclusion of venous aneurysms in three cases, involving the external iliac, common femoral, and profunda femoris veins. The patients provided written informed consent for the report of their case details and imaging studies.

CASE REPORTS

Patient 1

Clinical presentation. A 42-year-old man with a history of brain meningioma after resection, recurrent pulmonary embolism treated with rivaroxaban, obesity, chronic kidney disease stage III, depression, and bilateral lower extremity chronic venous insufficiency presented to our clinic in the setting of bilateral lower extremity swelling, heaviness, and tiredness and right lower extremity hyperpigmentation. He had a history of prophylactic inferior vena cava (IVC) filter placement (Trapease; Cordis) in 2014 before bariatric surgery. However, the filter was not removed and subsequently became occluded. His anticoagulation therapy was rivaroxaban 20 mg daily. Clinical examination revealed extensive collateralization, particularly involving the abdominal wall, with associated pain and discomfort. The right leg had CEAP (clinical, etiologic, anatomic, pathophysiologic) clinical class C4 and the left leg, CEAP clinical class C3. The venous clinical severity score (VCSS) was 6 for the left leg and 13 for the right leg. Computed tomography revealed a large aneurysm of the left external iliac vein (85 mm × 45 mm; Fig 1, *A and B*). The bilateral common iliac veins were occluded, as was the infrarenal IVC, including the filter. In light of his presentation and findings, a plan was formulated to sequentially recanalize the right side, attempt removal of the TrapEase filter, and then treat the left side, including exclusion of the external iliac vein aneurysm.

Intervention. Under ultrasound guidance, access to the right mid-thigh femoral vein was obtained, and an 11F access sheath was placed. Recanalization was obtained across the occluded common iliac and caval segment, including the IVC filter using a 0.035-in. Glidewire and Glidecath supported by an 8F, 63-cm Swartz transseptal introducer sheath (Abbott Cardiovascular). On careful evaluation of the filter, it appeared to be fragile, especially at the junction of the tapered segment to the horizontal part. The concern was that in trying to collapse the filter (from the cranial and caudal directions) to retrieve it, separation of the structure could occur, thereby making it irretrievable with an increased risk for complications. Thus, it was decided to proceed with recanalization of the occluded TrapEase IVC filter and, in the process, salvage it. This was done using a 0.035-in. Glidewire and Glidecath. Intravascular ultrasound (IVUS) interrogation was then performed across four segments (ie, the common femoral vein, external iliac vein, common iliac vein, and distal IVC) to ensure that we were in the right trajectory for recanalization. IVUS confirmed we were within the common femoral vein caudally and in the suprarenal IVC cranially. The recanalization tract was enlarged initially using a 10 × 60-mm

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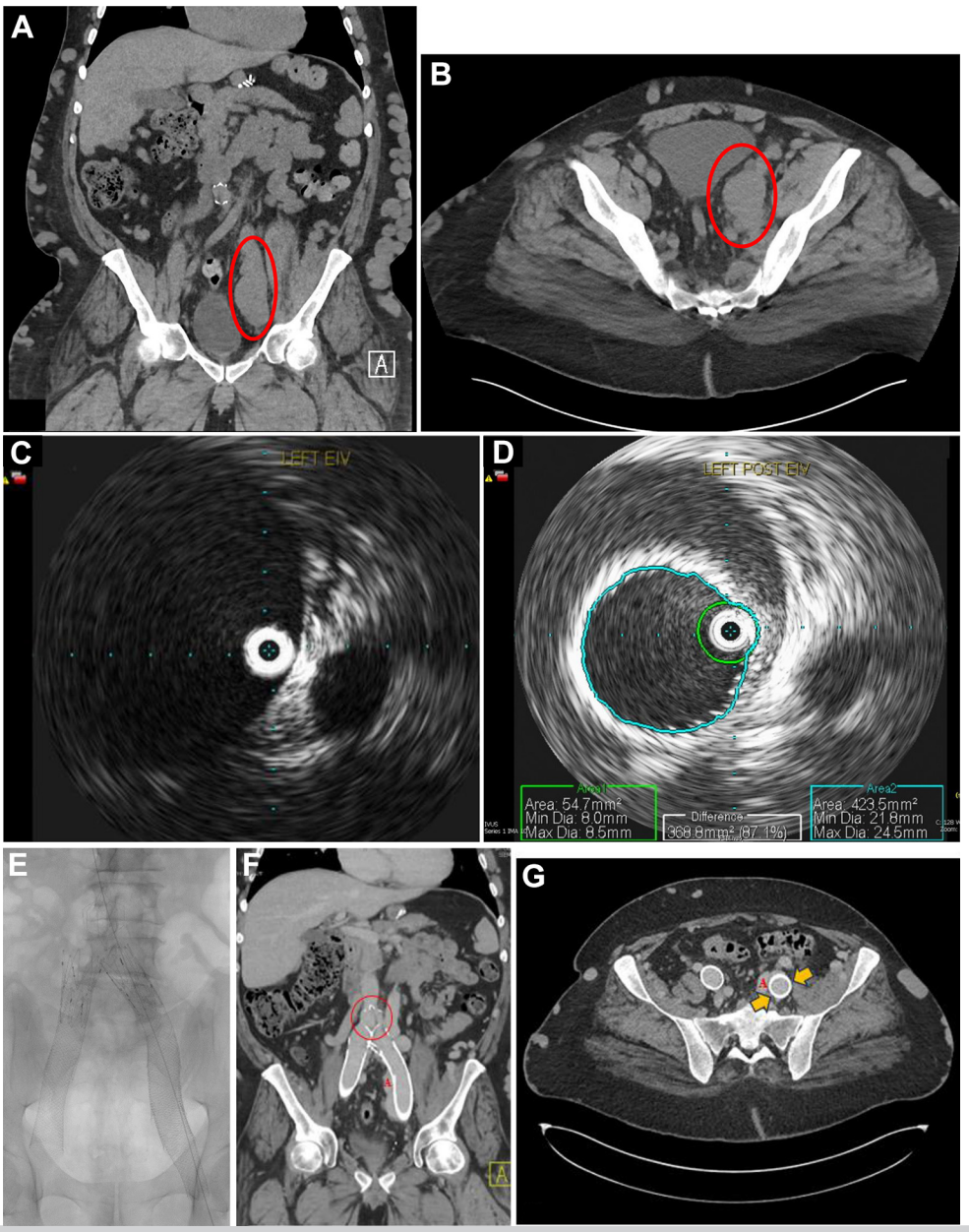

Fig 1. Computed tomography images depicting left external iliac vein aneurysm (*red ovals*) in patient 1 on coronal (**A**) and axial (**B**) views. Intraprocedural intravascular ultrasound (IVUS) images demonstrating left external iliac aneurysm in patient 1 before stenting (**C**) and after two-layer stent exclusion (**D**). Note the continued filling of the aneurysm sac outside the stent after exclusion (hypoechoic area outside stent). This is expected, given the nature of the stent, and successful thrombosis was noted on duplex ultrasound (DUS) at 4 weeks of follow-up. **E,** Stent configuration in patient 1. A composite Wallstent Z stent configuration was used because the procedure involved recanalization of the bilateral common iliac–distal inferior vena cava (IVC), in addition to exclusion of the left external iliac venous aneurysm. A two-layer Wallstent was used to successfully exclude the aneurysm over its extent on the left side. Technical details are provided in the text. Computed tomography venography (CTV) images showing patent bilateral femoroiliocaval stents and patent IVC filter (*red circle*) on coronal view (**F**) and demonstrating successful stent exclusion at 14 months after the procedure (*orange arrows*) on axial view (**G**). *A,* Artery.

angioplasty balloon and, subsequently, a 18 × 60-mm angioplasty balloon. This angioplasty was performed across the external iliac vein, common iliac vein, and distal IVC, including through the filter. For the latter, the balloon was carefully angled to avoid disrupting the filter. A 24 × 40-mm angioplasty balloon was also used to further enlarge the tract across the common iliac segment on the right side and the filter. Interval IVUS interrogation demonstrated a reasonable channel across the

IVC filter. Stenting was then performed across the common femoral, external iliac, and common iliac veins and distal IVC below the filter using two 24 × 70-mm Wallstents. A 30 × 50-mm Z stent was used across the iliocaval confluence abutting the filter. IVUS interrogation and venography demonstrated adequacy of the luminal caliber across the stent and the IVC, including the filter.

Two days later, the left side was recanalized using a similar technique, and the external iliac vein aneurysm was excluded using 24 × 70-mm Wallstents with a two-layer stent overlap across the aneurysm. IVUS was used to confirm the diagnosis and determine the stent landing points to treat the occlusion and exclude the aneurysm (Fig 1, *C and D*). A total of four 24 × 70-mm Wallstents and one 30 × 50-mm Z stent were used on the left side, again abutting the IVC filter to provide adequate outflow (Fig 1, *E*). Given the nature of the procedure and his history, he was discharged with rivaroxaban 15 mg twice daily for 30 days, with a return to his baseline rivaroxaban dose of 20 mg daily.

Outcome. At 14 months after intervention, his leg and truncal symptoms, including swelling, heaviness, and discomfort have improved, as have his truncal and lower extremity venous varicosities. The VCSS improved to 4 for both legs. Duplex ultrasound (DUS) revealed bilateral patent stents and a thrombosed aneurysmal sac at 4 weeks after intervention. Computed tomography venography (CTV) at 14 months after intervention demonstrated patent stents and a patent IVC filter (Fig 1, *F*) with successful aneurysm exclusion (Fig 1, *G*). He will be followed up in the long term with routine clinical evaluations and DUS.

Patient 2

Clinical presentation. A 79-year-old man had experienced pain, swelling, and heaviness, in addition to venous leg ulcers (left more than right), with quality-of-life impairment for many years (bilateral CEAP clinical class C6). At the time of presentation, the medial malleolar ulcers had been present for >1 year on the right side and for many months on the left. He also had a history of deep vein thrombosis involving his legs and had consequently been prescribed apixaban. In addition, he had had metastatic prostate cancer and a groin hernia. He was unable to wear compression stockings because of the pain. The right leg was more symptomatic and had a VCSS of 20; the VCSS for the left leg was 15. CTV revealed a left common femoral venous aneurysm, 29 mm × 19 mm (Fig 2, *A*), with additional severe stenosis of the left common iliac segment.

Intervention. Given his presentation, it was decided to proceed with intervention. Ultrasound-guided access of the left mid-thigh femoral vein was attained and an 11F access sheath placed. IVUS interrogation was performed of four segments: the common femoral vein, external iliac vein, common iliac vein, and distal IVC. This confirmed the common femoral venous aneurysm (Fig 2, *B*) and post-thrombotic stenosis of the common iliac venous segment. Thus, selective angioplasty of the external iliac vein, common iliac vein, and distal IVC was performed using an 18 × 40-mm angioplasty balloon. Stenting was accomplished using a 20 × 120-mm Abre stent (Medtronic) across the common iliac segment and extending into the IVC. The external iliac and common femoral veins were stented using three 18 × 90-mm Wallstents. Stent overlap ensuring a two-layer stent coverage across the aneurysmal segment was pursued. Postdilation of the entire stent column was performed with the previously used 18 × 40-mm angioplasty balloon. Femoral vein angioplasty using a 8 × 60-mm angioplasty balloon to improve inflow was also performed because of the post-thrombotic changes in this segment. Completion IVUS interrogation was subsequently performed, which demonstrated successful stent exclusion of the aneurysm(Fig 2, *C*).

Outcome. At 4 months after intervention, the ulcer on the right leg has healed, and the left leg ulcer has significantly decreased in size. His legs overall feel a lot better in terms of swelling, heaviness, and pain, enabling him to tolerate compression stockings and also to be more active. The VCSS improved to 10 on the right and 15 on the left. He is taking apixaban 5 mg twice daily with the plan to continue it long term. CTV at 4 months (Fig 2, *D*) demonstrated a patent stent with a barely discernable aneurysm around the common femoral stent, characterizing successful exclusion and subsequent remodeling.

Patient 3

Clinical presentation. A 75-year-old woman with history of Klippel-Trenaunay syndrome, chronic venous insufficiency on the left side, and lymphedema had undergone left iliofemoral venous stenting in the past. She presented with worsening, recurrent left leg swelling, heaviness, and tiredness. She had a recent history of bilateral pulmonary embolism for which she had originally been taking apixaban 5 mg twice daily but that was switched by her internist to warfarin. The CEAP clinical class was C4 and the VCSS was 11. The diagnostic workup included duplex ultrasound, which revealed significant in-stent restenosis (ISR), likely the cause of stent malfunction leading to recurrent symptoms. CTV confirmed the ISR but also revealed two aneurysms involving the left profunda femoris vein in the mid- to distal thigh (maximal aneurysm diameters: superior ~21 mm and inferior ~27 mm; Fig 3, *A and B*). In light of these dual problems, a plan was made to access the left popliteal/posterior tibial vein with the intent to treat the ISR and then endovascularly exclude the aneurysm in the same session.

Intervention. Under general anesthesia and using ultrasound guidance, access to the left upper leg posterior tibial vein was obtained using a micropuncture technique, and a 9F, 10-cm sheath was placed. Using a V-18, 300-mm wire (Boston Scientific), we were able to cannulate the deep femoral vein, cross the aneurysms, and enter the IVC. The V-18 wire was switched to a 0.035-in. Glidewire. CTV (Fig 3, *C*), followed by IVUS interrogation (Visions PV 0.035-in. digital IVUS catheter; Philips Healthcare), was performed. The imaging studies confirmed the diagnosis of ISR, with additional stent compression and worsening of post-thrombotic changes in the common femoral vein below the stent. IVUS enabled precise definition of the two profunda femoris vein aneurysms and determination of the landing zones

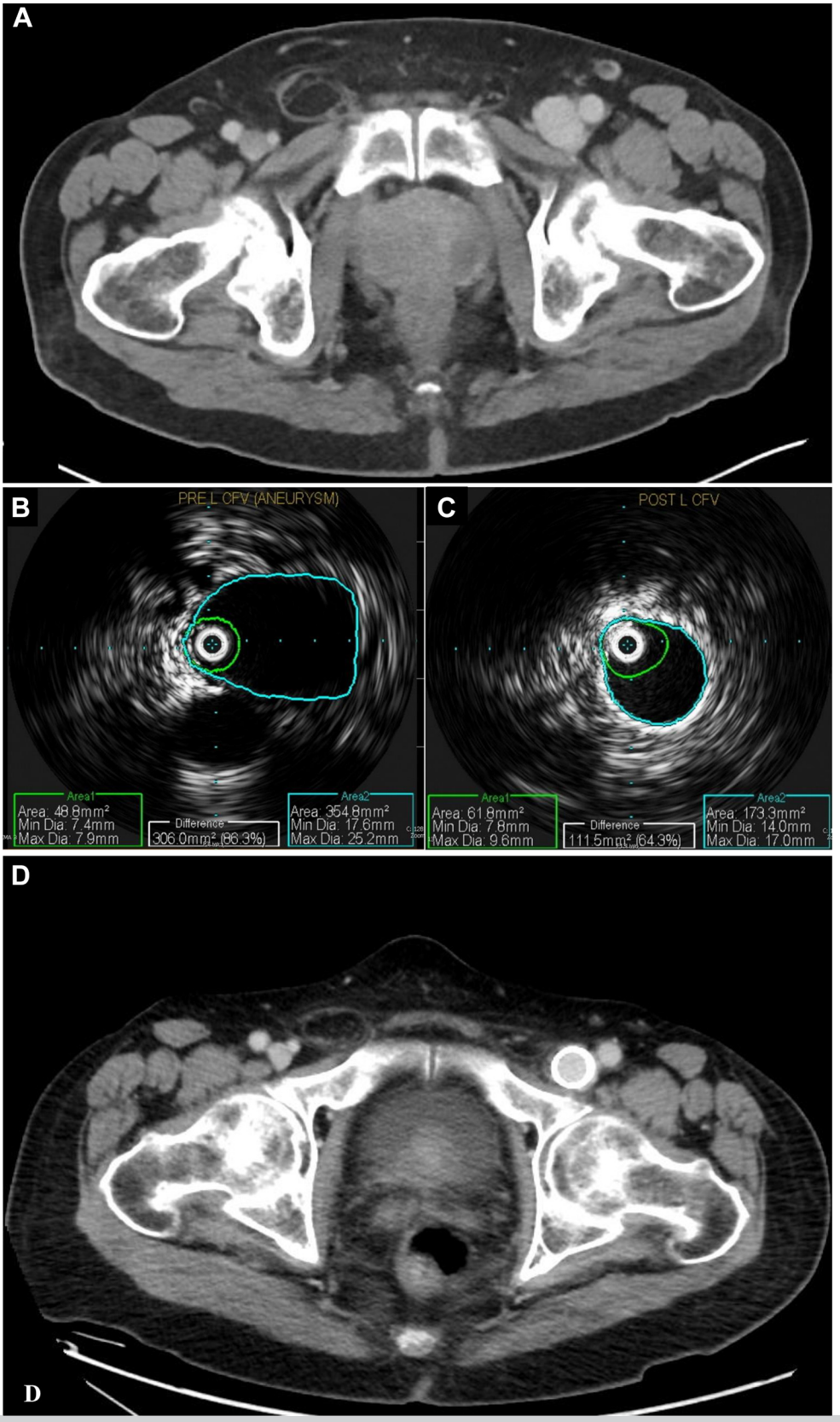

Fig 2. A, Axial computed tomography venography (CTV) image depicting the left common femoral vein aneurysm in patient 2 before intervention. Intraprocedural IVUS images demonstrating the left common femoral venous aneurysm before stenting (**B**) and after successful stent exclusion (**C**). **D,** Axial CTV image depicting the left common femoral vein aneurysm in patient 2 after successful stent exclusion and remodeling at 4 months after the procedure.

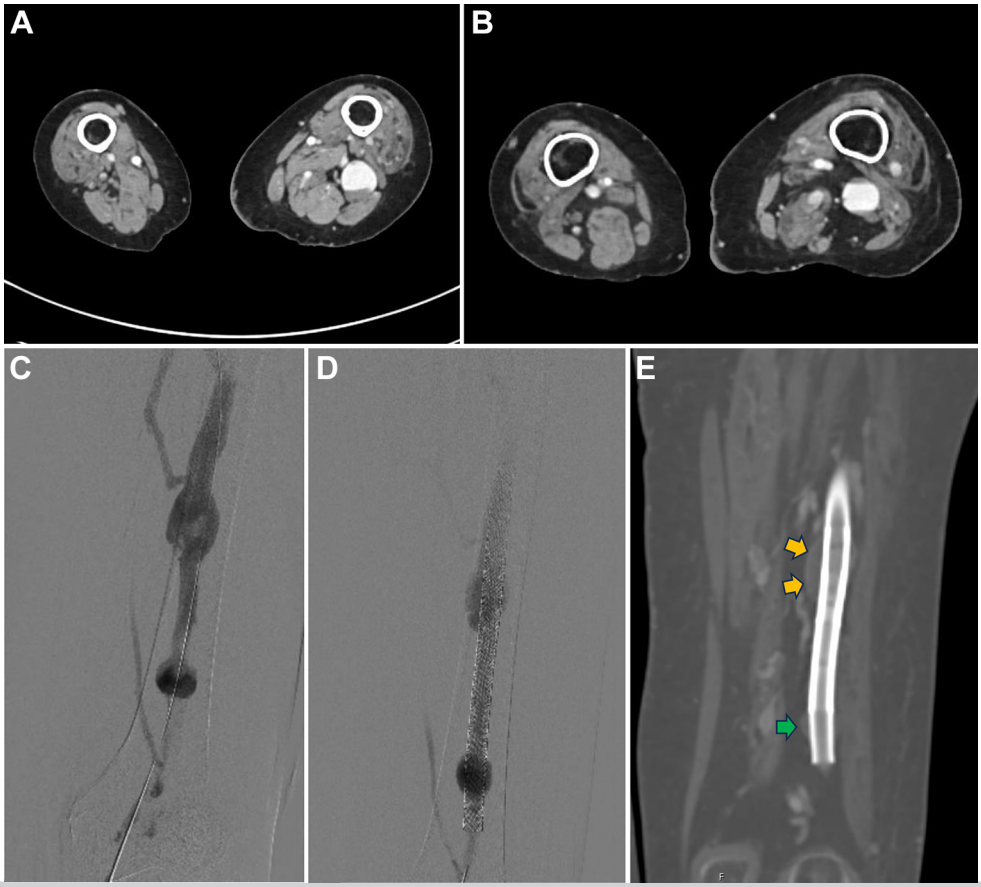

Fig 3. Axial computed tomography venography (CTV) images depicting left profunda femoris vein aneurysms in patient 3: superior aneurysm (**A**) and inferior aneurysm (**B**). CTV demonstrating left profunda femoris vein aneurysms in patient 3: before stent exclusion (**C**) and after stent exclusion (**D**). Note the continued filling of the aneurysm sacs after exclusion. This is expected, with thrombosis occurring subsequently, given the venous flow properties. **D,** Coronal CTV image 8 months after intervention depicting left profunda femoris vein aneurysms in patient 3 that have since undergone successful stent exclusion. *Arrows* depict thrombosed sac: *orange arrows,* superior aneurysm; and *green arrow,* inferior aneurysm.

for stent exclusion. Also, post-thrombotic stenosis was present in the deep femoral vein above and below the aneurysms. Thus, we proceeded with angioplasty of the profunda femoris vein above and below the aneurysms using an EverCross 8 × 60-mm angioplasty balloon (Medtronic) to enable smooth tracking of a longer sheath. This was performed to avoid having to retrieve the large balloon that would be required for stent angioplasty across the path of the aneurysms. We then switched the 9F, 10-cm sheath to a 12F, 45-cm sheath and placed it in the deep femoral vein just below the femoral confluence and above the aneurysms. Angioplasty was then performed across four segments (common femoral vein, complex external iliac vein, common iliac vein, and distal IVC) within the stent using an 18 × 40-mm Atlas Gold angioplasty balloon (Becton, Dickinson and Co). Stent extension was then accomplished using an 18 × 90-mm Wallstent (Boston Scientific) to improve inflow, followed by postdilation. To treat the deep femoral venous aneurysms, the 12F, 45-cm sheath was then switched back to a 9F, 10-cm sheath. Using a combination of three 10-mm × 90-mm Wallstents, both the aneurysms were excluded with a two-layer stent overlap over the aneurysmal areas (Fig 3, *D*). An 8 × 60-mm EverCross angioplasty balloon (Medtronic) was used to ensure adequate approximation of the stent to the normal vein cranially and caudally to the aneurysms. IVUS interrogation confirmed the adequacy of the luminal area across the stented segment and successful exclusion of the aneurysms.

Outcome. At 14 months after the procedure, she is doing well with symptom relief. Complex decongestive therapy was pursued for her lymphedema. CTV at 8 months after intervention demonstrated a patent iliofemoral venous stent column and thrombosed and regressing aneurysms (Fig 3, *E*). Her VCSS had improved to 9. She is taking apixaban 2.5 mg twice daily and tolerating it without problems. Long-term clinical and DUS stent follow-up is being pursued.

DISCUSSION

Open surgical repair represents the most commonly described definitive treatment of femoral and iliac

venous aneurysms. Although cases have been reported of the use of an endovenous approach, they typically involve the use of a stent graft or coils. However, in the relatively slower flowing venous circulation, the risk of stent graft thrombosis is high. Also, the use of coils can lead to the risk of thrombosis of the aneurysm and, with it, the vein itself with loss of inline flow. Ross et al,[10] in their treatment of a patient with a symptomatic left femoral venous aneurysm, used a combination of coils and a 14 × 60-mm open-cell bare metal stent. At 15 months, the patient was reportedly doing well with a patent stent and excluded aneurysm.[10] However, the author's view is that with use of a closed cell stent, such as the Wallstent, the same result can be achieved without use of coils and their associated problems. In secondary venous aneurysms with chronic total occlusion of the iliocaval segment with an occluded filter, restoration of inline flow through recanalization is required first, before treatment of the aneurysm. Open surgery in such a setting, in addition to the risk of significant morbidity, does not offer good options. Open aneurysm repair with venous bypass or a hybrid approach with recanalization and subsequent open repair of aneurysm were not good options for patient 1. For patient 3, given her severe lymphedema, the risk of complications from open surgery involving exposure of the profunda vein in the mid- to distal thigh was high. Thus, an endovenous approach was selected for both patients. Finally, patient 2 had severe post-thrombotic stenosis of the left common iliac vein that required stenting.

The role of IVUS in enabling careful assessment of the extent of the aneurysm and concomitant femoroiliocaval pathology and, thereby, guiding precise stent deployment cannot be overstated. The use of a two-layer stent overlap is arbitrary, guided by the thinking that such an overlap will lead to less of an endoleak into the aneurysm sac and quicker thrombosis and sac contraction. This appears to have been achieved in the treatment for all three patients. It is important to remember that the presence of endoleaks initially (on completion venogram or early follow-up) is inevitable with the use of bare metal stents and even with coil embolization, as Ross et al[10] noted in their report. This should not be considered a sign of failure, such as in the management of arterial aneurysms, because adequately excluded venous aneurysms will thrombose within a few weeks, given venous flow properties. The use of a woven stent with its closed cell configuration is likely better suited than a stent with an open cell configuration because of the likelihood of a high-volume endoleak and the persistence of the aneurysm with the latter. All three patients in this series had thrombosis of the aneurysm sac noted on DUS by week 4 after stent exclusion.

Regarding anticoagulation therapy, all three patients had femoroiliocaval pathology and additional venous thromboembolic event risk (patients 1 and 2), in addition to the aneurysms, necessitating anticoagulation therapy. For patients without a history of venous thromboembolism or thrombophilia and without chronic iliofemoral venous obstruction on IVUS, the use of anticoagulation might only be indicated for selected cases (eg, patients receiving hormonal therapy, patients who developed early [within 3 months] ISR or stent compression with leg symptoms impairing their quality of life for whom conservative therapy had failed; and in the setting of stent occlusion).

The successful endovascular exclusion of femoral and iliac venous aneurysms using woven or closed cell, bare metal stents support the safety and feasibility of treating this rare, but challenging, condition using a minimally invasive approach, thereby mitigating the potential complications associated with an open approach. Long-term follow-up remains important.

CONCLUSIONS

Stenting using Wallstents is a safe and effective method to exclude femoral and iliac venous aneurysms at mid-term follow-up. Further corroboration and long-term data are warranted.

DISCLOSURES

None.

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