Reconstruction of the iliocaval venous confluence using arterial stent technology

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ABSTRACT

Reconstruction of the iliocaval confluence remains a challenge for physicians performing interventions in the deep venous system. We report a case of caval bi-iliac occlusion in which arterial stent technology in the form of the AFX2 unibody stent graft (Endologix, Irvine, Calif) was used to achieve anatomic reconstruction of the iliocaval confluence. (J Vasc Surg Cases and Innovative Techniques 2020;6:247-9.)

Keywords: Venous intervention; Post-thrombotic syndrome; Inferior vena cava; Arterial stent

The sequelae of iliofemoral deep venous thrombosis (DVT) at times require the recanalization and reconstruction of the iliocaval confluence. Although advancements in engineering have led to a dedicated stent design featuring high radial forces, these features have not been incorporated into devices that can be used in this anatomic location. Current strategies for such iliocaval confluence reconstruction include the double-barrel, apposition, fenestration, and confluence techniques.[1,2] These techniques are limited by space constraints, strut interactions at the confluence, and impairment of potential reinterventions.[1,2] Most significantly, they fail to reconstruct the native anatomy of the confluence, which may have an impact on hemodynamics and contribute to an increased risk of failure.

Technology applied to arterial stenting of the aortic bifurcation may offer a solution to the dilemma of how to effectively reconstruct the iliocaval confluence. We report a case of successful treatment of a chronic caval bi-iliac occlusion using the AFX2 unibody stent graft system (Endologix, Irvine, Calif). The patient provided informed consent for publication.

CASE REPORT

A 57-year-old white woman presented to our institution 1 week after a cardioablative procedure through a right common femoral vein cannulation. This was aborted because of an occluded inferior vena cava (IVC). Despite being promptly restarted on apixaban for paroxysmal atrial fibrillation, she developed acute right leg pain and extensive edema to the level of the proximal thigh. Ultrasound assessment confirmed an iliocaval DVT with femoropopliteal vein involvement. There was no evidence of pulmonary embolus.

The patient described a previous diagnosis of extensive left-sided DVT 20 years ago. She had been experiencing chronic left leg edema and venous claudication with progressive hemosiderin deposition since that time. She had not previously suffered from any right leg symptoms, nor did she demonstrate any stigmata of chronic venous disease in her right leg.

Computed tomography (CT) venography demonstrated a chronic IVC occlusion with reconstitution of the intrahepatic IVC and multiple collaterals draining through the azygos system. Acute thrombus was seen within the right femoral vein extending to the right external iliac vein. In addition, calcified "chronic" thrombus was identified within both common iliac veins and the left external iliac vein (Fig 1). There was no suggestion of May-Thurner compression or malignant disease. Thrombophilia screen was unremarkable.

In this case, despite the early recommencement of apixaban, instrumentation of the patient's right iliofemoral venous system resulted in acute-on-chronic thrombosis, with subsequent loss of venous collaterals and associated symptoms. Initial management consisted of cessation of apixaban and starting of therapeutic enoxaparin (1 mg/kg twice daily) as well as intermittent pneumatic compression and leg elevation. After 3 days of conservative treatment, the patient remained in pain with gross edema. Definitive treatment options were discussed, including the off-label use of the AFX2 stent graft to reconstruct the caval confluence.

Pharmacomechanical thrombectomy was performed, followed by iliocaval stenting under general anesthesia. An 8 F sheath was placed in the right popliteal vein to facilitate clearance of acute iliofemoral thrombus using the AngioJet peripheral thrombectomy system with the ZelanteDVT catheter (Boston Scientific, Marlborough, Mass). Intravascular ultrasound (IVUS) confirmed clearance of thrombus, and bilateral femoral

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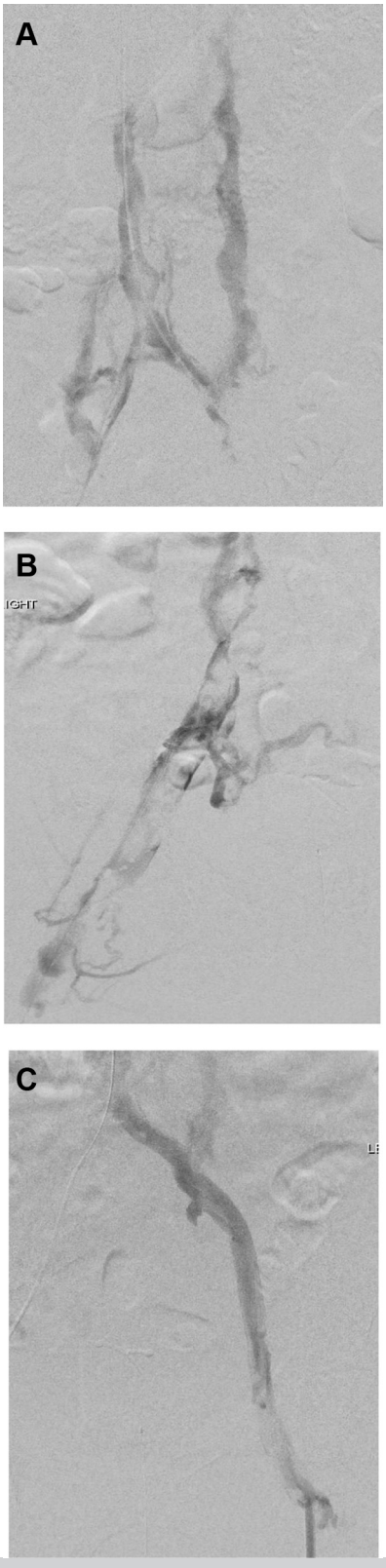

Fig 1. Preintervention diagnostic venography demonstrating **(A)** disease throughout the iliocaval confluence and inferior vena cava (IVC) with a dominant azygos system, **(B)** acute thrombus within the right iliac venous system, and **(C)** partial recanalization within a diseased left iliac venous system.

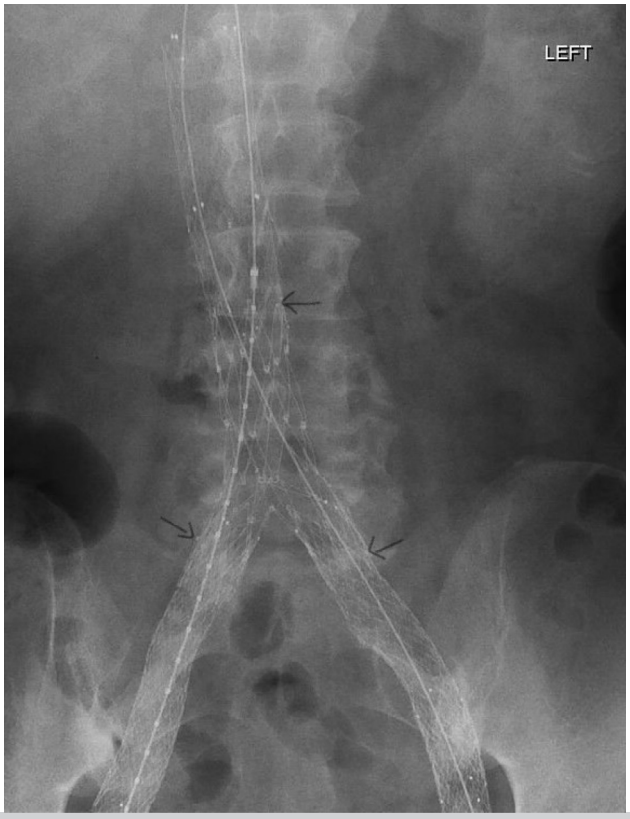

Fig 2. Completion imaging with the proximal and distal ends of the AFX2 stent highlighted by *arrows*.

vein punctures were then performed. Under ultrasound guidance to avoid valves, a Perclose ProGlide (Abbott Vascular, Santa Clara, Calif) was placed in the right femoral vein and the sheath upsized to 17F. A 10F sheath was required in the left femoral vein.

The diseased iliocaval segment was crossed from the left side and predilated with a 16-mm Atlas balloon (BD Bard, Covington, Ga) to allow wire advancement across the diseased right-sided segment into the same channel within the IVC. Further predilation with two 16-mm Atlas balloons in a double-barrel configuration was then performed in the IVC. The AFX2 stent was then deployed across the caval confluence (22- × 30-mm main body with 16- × 70-mm limbs). This was reinforced proximally with a 22- × 40-mm sinus-XL stent (OptiMed, Ettlingen, Germany), and an additional 24- × 60-mm sinus-XL stent was extended to the level of the twelfth thoracic vertebra to treat the proximal synechiae. Venovo stents (BD Bard) were then placed distally to reinforce the limbs of the AFX stent and to treat the distal iliac vein disease (16 × 100 mm to the right external iliac vein and 14 × 140 mm into the left common femoral vein, bridged to the AFX2 stent with a 16- × 100-mm stent). Stent sizing and positioning were guided by IVUS. Appropriately sized Atlas balloons were then used to postdilate all stents before IVUS and check venography-confirmed procedural success (Fig 2). Throughout the case, the activated clotting time was maintained at >250 seconds.

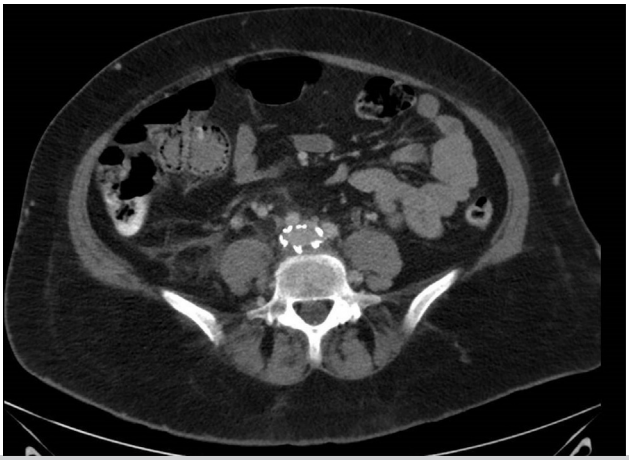

Fig 3. Postoperative plain computed tomography (CT) image demonstrating a widely patent caval confluence due to the single-lumen AFX2 stent.

Sequential compression devices were commenced in recovery, and a dose of enoxaparin (1.5 mg/kg) was administered. Apixaban (5 mg twice daily) was commenced on the first postoperative day, and at this time, a non-contrast-enhanced CT scan demonstrated satisfactory stent placement and configuration (Fig 3).

Three-month follow-up revealed patent stents with no stenosis on CT venography. Symptoms and edema had resolved completely. Further follow-up with clinical review and ultrasound imaging of the stents will be scheduled at 3-month intervals for the first year and then annually thereafter.

DISCUSSION

Reconstructing the iliocaval confluence is challenging. We have previously used the established double-barrel technique to reconstruct the iliocaval confluence; however, we have noted occasional failures. Reasons for this may be twofold: space constraints at the caval confluence leading to incomplete stent expansion despite aggressive predilation and postdilation; and proliferation of fibrous tissue in the layers separating the stents, preventing flow mixing between open-cell stents and compromising hemodynamics. We therefore thought that the ability to anatomically reconstruct the iliocaval confluence would overcome this problem and restore relatively normal hemodynamics to the confluence, potentially improving long-term durability.

The limitation of such technology is that arterial stents do not have all the desirable characteristics of venous stents, particularly the radial force required to resist post-thrombotic recoil. To prevent compression and collapse of the AFX2 stent, we deployed dedicated venous stents at the proximal body and distal limbs of the AFX2 stent. This preserved the luminal area of the AFX2 stent as was demonstrated by IVUS and follow-up CT imaging.

Another consideration is the covered stent design of the AFX2 stent. Polytetrafluoroethylene grafts are routinely used in open surgical reconstruction of the IVC, with reported primary patency rates of up to 92% at 5 years[3] and a mode of failure often related to tumor recurrence,[4] which is not an issue in this case. These patients also tend to be treated with long-term antiplatelet therapy in an attempt to prevent graft thrombosis.[4,5] In contrast, our approach is to prescribe long-term anticoagulation (not antiplatelet) therapy for patients undergoing complex venous intervention owing to the evidence that fibrin-rich thrombi are more relevant than platelet aggregation in venous thrombosis, and anticoagulants are a more effective prophylactic therapy.[6] The likelihood of the covered polytetrafluoroethylene component of the AFX2 stent contributing to failure is therefore unlikely.

CONCLUSIONS

Reconstruction of the iliocaval confluence is a challenge facing physicians who undertake complex deep venous interventions. Arterial technology, such as that demonstrated by the AFX2 stent, has a role to play for such reconstructions in the short term. However, technology must evolve to combine the desirable traits of the AFX2 stent and venous stents into a dedicated stent to treat the iliocaval confluence.

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