Percutaneous Recanalization of a Previously Ligated IVC

In selected patients, percutaneous recanalization of a surgically ligated IVC can offer an endovascular alternative to open surgery.

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Before the advent of heparin and inferior vena cava (IVC) filters, treatment of pulmonary embolism (PE), including surgical embolectomy, was first described in 1908. Heparin therapy was first introduced in the late 1930s. IVC ligation was first described by Collins in 1943 during the early days of anticoagulation and 17 years before the first randomized clinical trial evaluating the efficacy of heparin in the treatment of PE.[1] The long-term sequelae of IVC occlusion including lower extremity varicose veins, edema, skin pigmentation (lipodermatosclerosis), and ulceration are well documented.[2,3] The literature is replete with endovascular strategies for the management of chronic nonmalignant IVC obstruction.[4,5] We report a novel approach for endovascular recanalization of the IVC in a patient who had previously undergone surgical ligation and was suffering from long-standing lower extremity venous ulcers. This procedure was successfully performed using sharp endovascular puncture of the ligated segment of the IVC with subsequent placement of a covered stent, achieving excellent radiographic and clinical results.

SUBJECTS AND METHODS

A 63-year-old man initially presented to the interventional radiology clinic complaining of long-standing edema complicated by large concentric ulcers of the bilateral lower legs. His medical history was significant for type 2 diabetes mellitus, chronic obstructive pulmonary disease, and ongoing methicillin-resistant *Staphylococcus aureus bacteremia* (MRSA).

> Vascular surgery was initially consulted for amputation of the right great toe; however, the patient refused any surgical intervention.

His first episode of PE occurred in 1969 when he was 21 years of age. He underwent bilateral lower extremity venography, which showed extensive deep venous thrombosis extending into the IVC. He was managed with intravenous heparin and warfarin. In 1972, he presented with a second episode of PE, which led to the placement of an IVC filter—possibly a Mobin-Uddin umbrella filter. At the time of initial presentation, he was still being maintained on a therapeutic warfarin regimen. In 1975, he developed a third episode of severe PE while on warfarin, which led to the decision to perform surgical IVC ligation.

Due to a history of iodine contrast allergy, the patient received limited, if any, postsurgical radiographic follow-up. In November 2009, the patient tested positive for lupus anticoagulant with a value of 2.66. Approximately 15 years after the ligation (circa 1990), the patient started to develop the lower extremity sequelae of chronic IVC occlusion including edema, pain, skin pigmentation, and ulceration, which were managed conservatively. Over the course of the subsequent 15 to 20 years, ulcers in both legs progressed, and during the days prior to an admission in July 2010, he developed foul-smelling purulent discharge and

Figure 1. Large circumferential and superficial typical venous ulcers with irregular margins, involving the lower legs and containing red granular tissue and a superficial fibrinous gelatinous exudate. The surrounding skin is hyperpigmented with lipodermatosclerosis, and the legs are edematous. Notice the ulcer on the bottom of the right hallux, with purulent discharge (arrow).

increased pain. Because he did not wish to undergo any surgical intervention, the patient was treated with continued wound care and initiation of intravenous antibiotics.

He presented again in October 2010 with fever. On examination, extensive CEAP grade 6[6] circumferential venous ulcers involving both legs at the level of the calves were noted, and there was an ulcer at the bottom of the right hallux with exposed bone and purulent discharge (Figure 1), which had been worsening for several months. Radiography performed at that time showed findings that were suspicious for osteomyelitis. Blood cultures were positive for MRSA. The patient was managed with a 6-week course of intravenous antibiotics, and wound care was recommended by the infectious disease team. Vascular surgery was initially consulted for amputation of the right great toe; however, the patient refused any surgical intervention. Interventional radiology and vascular surgery services were consulted in regard to management of the venous stasis ulcers. There was broad consensus that as long as the IVC occlusion persisted, the ulcers would not heal, and recanalization was necessary. Surgical options were limited due to the patient's large body habitus, previous IVC surgery, and the anticipated technical challenges of operating on the IVC. The interventional radiology department offered a percutaneous recanalization as a viable possibility.

Initial diagnostic imaging evaluation of the patient included conventional inferior vena cavography via right common femoral vein access with an Omniflush catheter (AngioDynamics, Inc., Queensbury, NY) placed in the IVC just above its bifurcation (Figure 2A and 2B) and computed tomographic (CT) venography with coronal and sagittal reconstructions. These exams demonstrated that the IVC had been ligated just below the level of the renal veins. There was a large pouch/varix of the mid-infrarenal IVC, just caudal to the ligation point (Figure 2). The pouch drained into a large unnamed

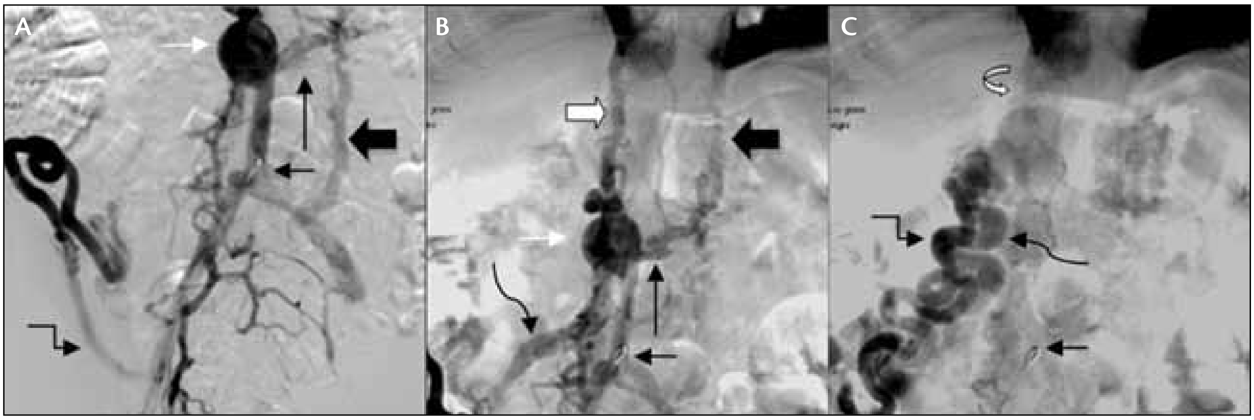

Figure 2. Early inferior venacavography with the tip of an Omniflush catheter placed at the IVC bifurcation (horizontal thin black arrow) (A). There is a large pouch just caudal to the ligation point (horizontal thin white arrow). Left ascending lumbar vein (thick black arrow), circumaortic left renal vein (vertical arrow), and right external iliac vein collateral draining into right renal vein (squared arrow) are also shown. Mid-phase venography (B). Drainage from the pouch is via a large right L3 lumbar vein into the azygos vein (thick white arrow) and a large right retroperitoneal collateral vein (curved black arrow), which drains into the right renal vein, and a large circumaortic left renal vein (vertical black arrow), which joins the left ascending lumbar vein (thick black arrow). Late-phase venography (C). The branch from the pouch draining into the right renal vein is well visualized (oblique black arrow) opacifying the IVC above the ligation point (curved white arrow). Collateral drainage from the right external iliac vein into the right renal vein (squared arrow, also seen in A) is redemonstrated here.

Figure 3. Anteroposterior (A) and lateral view (B) of the IVC. A pigtail catheter was placed from the right external jugular vein approach. A 12-F sheath was placed from the common femoral vein approach over a wire. Notice the caval ligation site (black arrow), extraluminal IVC filter (thick white arrow), and the lumbar L3 branch draining into the azygos vein (horizontal white arrow, also seen in A).

retroperitoneal collateral venous channel, which traveled through the retroperitoneum into the right renal vein (Figure 2B and 2C). Collateral drainage from the right external iliac vein into the right renal vein was also demonstrated (Figure 2A and 2C). Cranial to the pouch, a large right third lumbar vein provided drainage via the paraspinal plexus, which then drained into the azygos vein cranially to the level of the right renal vein.

The large branch off the right external iliac vein, which provided drainage through a large varix and also into the right renal vein, was well visualized on angiography but not on CT (Figure 2A). A large circumaortic left renal vein also provided collateral drainage into the main left renal vein (Figure 2A). To the left of the spine, a left ascending lumbar vein starting caudally at the left external iliac vein extended cranially to join the left renal vein and continued into the chest as the hemiazygos vein (not shown). Additional drainage was provided by subcutaneous branches of the common femoral veins bilaterally, which collateralized to the intercostal and axillary veins bilaterally. An IVC filter, possibly a Mobin-Uddin umbrella type, was visualized outside the IVC, just in front of the upper fourth lumbar endplate and to the right of the midline (Figure 3).

After standard premedication for contrast allergy (50 mg of prednisone orally 12 hours and 1 hour before, 50 mg of intravenous diphenhydramine 1 hour before, and 50 mg of intravenous ranitidine 1 hour before the procedure), informed written consent was obtained. Antibiotics in the form of 1,000 mg of intravenous vancomycin and 80 mg of intravenous gentamicin were administered prior to the beginning of the procedure. Warfarin was discontinued for 2 days prior to the procedure. On the day of the procedure, the patient's international normalized ratio remained elevated at 1.7 but was corrected with fresh frozen plasma to a level of < 1.5. During the procedure, the patient received 2,500 units of intravenous heparin. Following the procedure, the patient resumed anticoagulation with warfarin.

The right common femoral vein was accessed percutaneously, and a 12-F vascular access sheath was placed with the tip of the sheath into the infrarenal IVC immediately caudal to the ligation site. The left common femoral vein was then accessed percutaneously, and a 6-F vascular access sheath was placed as an additional access, if needed. The right external jugular vein was accessed (as the internal was found to be occluded on ultrasound), and a 5-F vascular access sheath was placed. From the right external jugular vein, a pigtail catheter was placed into the suprarenal IVC, which was used as a target. A pigtail catheter was placed into the distal IVC, and inferior venacavography was performed in the anteroposterior and lateral planes (Figure 3) with

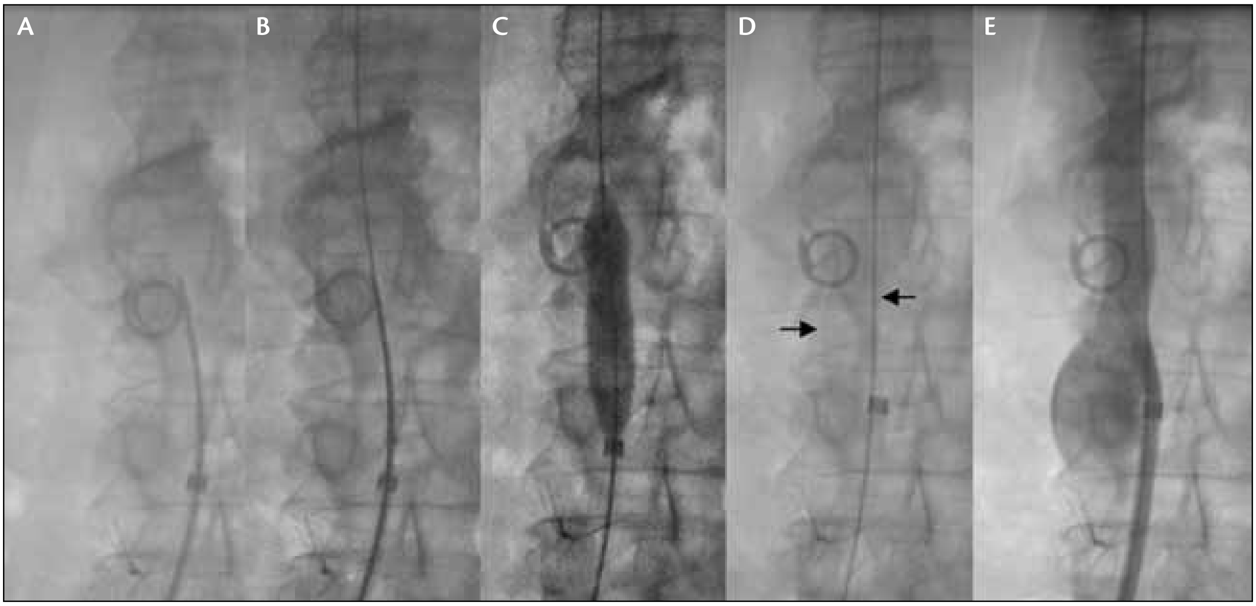

Figure 4. The Colapinto needle is placed through the 12-F sheath across the occlusion from the femoral vein approach, using the pigtail as a target (A). An Amplatz wire was advanced through the needle (B). The 13- X 50-mm Viabahn stent is placed across the occlusion and dilated using a 12- X 40-mm balloon dilation catheter (C). The dilated stent is in place (D, arrows). Contrast injected through the sheath shows adequate flow through the stent (E).

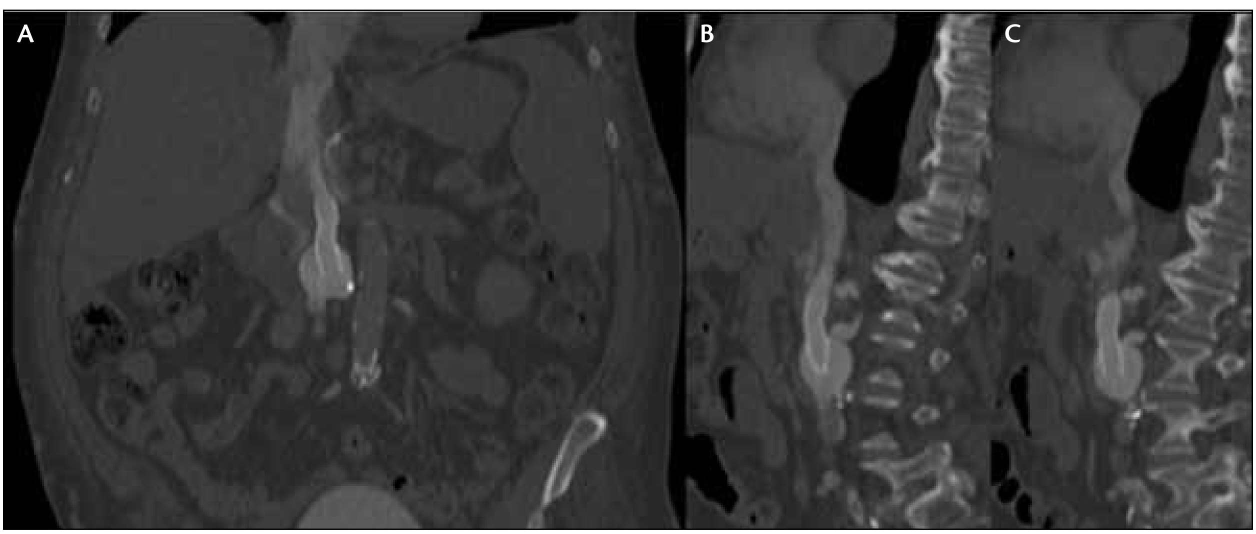

Figure 5. Coronal (A) and sagittal (B, C) CT reconstructions demonstrating patency of the recently placed covered stent.

additional rotational venography. From the right common femoral vein, a Colapinto needle was advanced through the sheath into the infrarenal IVC and used to traverse the ligated/occluded segment.

After three attempts, access was achieved into the suprarenal IVC (Figure 4A). A small amount of contrast was injected to confirm intraluminal positioning. An Amplatz wire (Cook Medical, Bloomington, IN) was placed through the needle across the occlusion (Figure 4B). The needle was removed, and an 8- X 40-mm high-pressure balloon dilation catheter was advanced. Angioplasty was performed at the site of ligation. A Viabahn 13- X 50-mm covered stent (Gore & Associates, Flagstaff, AZ) was placed across the previous ligation site and dilated using a 12- X 40-mm balloon dilation catheter (Atlas, Bard Peripheral Vascular, Inc., Tempe, AZ) (Figure 4C). Figure 4D shows the dilated covered stent in place. The completion contrast injection demonstrates recanalization of the previous occlusion without extravasation of contrast (Figure 4E). A

Figure 6. Six months after IVC recanalization, there was significant improvement with complete healing at the posterior aspect of the calves. Notice the ulcer in the bottom of the right hallux, which is dry and healing.

postprocedure CT was performed to further evaluate for hematoma and integrity of the neovessel (Figure 5).

There were no complications, including no contrast reaction. The patient reported improvement in symptoms almost immediately after the procedure. The patient has been followed clinically, and photographs were taken at 1 week, 1 month, 3 months, and 6 months (Figure 6) after the procedure, which showed a significant decrease of his previously severe edema and notable healing of the venous stasis ulcers. By 6 months postprocedure, the ulcer on the right hallux had almost completely healed, and there was no clinical evidence of ongoing infection including osteomyelitis.

DISCUSSION

Surgical IVC ligation for the treatment of chronic pulmonary embolism is no longer the standard of care. This case demonstrates the safety and feasibility of crossing this type of lesion with a Colapinto needle and bridging the channel with a covered stent. A covered stent was chosen because at the point of ligation, there was complete transection/occlusion of the IVC, and the covered stent was used to bridge the gap along an extravascular path to re-establish vascular continuity of the IVC. The Colapinto needle[7] has commonly been used for transjugular liver biopsy and transjugular intrahepatic portosystemic shunt, but additional reported uses include transvaginal/transrectal pelvic abscess drainage.[8,9]

Surgical venous bypass is known to be highly invasive, ineffective, and infrequently recommended because of high morbidity and failure rates.[10,11] Although this report includes only one patient and therefore represents a limited experience, we hope that this may assist a fellow colleague who is faced with a similar situation. Percutaneous recanalization of a previously surgically ligated IVC offers a novel and previously undescribed endovascular alternative to open surgery. ■

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