Suprarenal stricture of the inferior vena cava with massive ilio caval and distal thromboses successfully treated with catheter-directed thrombectomy, thrombolysis and angioplasty

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Long-term complications from deep vein thrombosis, such as post-thrombotic syndrome and chronic venous insufficiency, can result in significant morbidity for the affected patient. Although anticoagulation

has been the conventional method of treatment, the benefit of thrombus burden removal cannot be underestimated. The present case report describes the successful treatment of extensive ilio caval and distal thrombosis with suprarenal inferior vena cava stricture using catheter-directed thrombolysis, thrombectomy and angioplasty.

Key Words: Angioplasty; Deep vein thrombosis; Catheter-directed thrombolysis; IVC thrombosis; Thrombectomy

A 33-year-old male police officer presented with progressively worsening back pain and bilateral lower extremity swelling, as well as weakness and paresthesias that had worsened over the previous several months. The patient had a history of Crohn's disease, well controlled on mesalamine, and he was an occasional smoker. On admission, he was afebrile and his vital signs were stable. A physical examination was notable for bilateral edema at the ankles. There were palpable bilateral femoral, posterior tibial and dorsalis pedis pulses. There was no evidence of varicose veins, skin discolouration or ulcerations. The calves were bilaterally tender to palpation. Computed tomography (CT) of the abdomen and pelvis with contrast revealed thrombosis of the entire infrarenal inferior vena cava (IVC) and the bilateral iliac, femoral and popliteal veins (Figure 1). The suprarenal IVC appeared stenotic in the intrahepatic portion and there was evidence of collaterals from the IVC above and below the stenosis through the hepatic parenchyma. Varices were identified in the lumbar spine and

Figure 1 Computed tomography demonstrating intrahepatic inferior vena cava (IVC) calcification at level of stenosis (A), IVC thrombosis (B) and the distal IVC (C), with bilateral iliac vein thrombosis

Figure 2 Magnetic resonance imaging demonstrating dilated paraspinal veins

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Figure 3) Extensive thrombosis of the popliteal (A), ilio caval (B) and iliofemoral (C) systems

Figure 4) Debulking after thrombectomy of the femoropopliteal (A) and ilio caval (B) systems

pelvis. Magnetic resonance imaging of the lumbar and thoracic spine demonstrated dilated paraspinal and epidural veins with no evidence of arteriovenous malformation within the spinal canal and no evidence of intrinsic signal abnormalities involving the spinal cord (Figure 2).

The patient was started on a heparin drip after hypercoagulability workup was initiated. On hospital day 2, the patient was brought to the interventional radiology suite by the combined interventional radiology and vascular surgical team. The patient was placed in the prone position and ultrasound-guided right popliteal vein puncture was performed with 4 Fr micropuncture technique. Contrast injected through the micropuncture catheter demonstrated a thrombosed right femoropopliteal system. Exchange was made for a multiple sidehole infusion catheter. After the catheter and guidewire combination was advanced to the level of the IVC through the thrombosed ilio-caval system (Figure 3), 15 mg of tissue plasminogen activator (tPA) was used to lase the thrombus. This entire procedure was repeated on the left side. A 6 Fr Angiojet (Possis Medical, USA) thrombectomy catheter was then used to perform thrombectomy of the ilio-caval and femoropopliteal systems

bilaterally, with venography demonstrating successful debulking of approximately 70% to 80% of the thrombus (Figure 4). Two 4 Fr Cragg-McNamara (Micro Therapeutics Inc, USA) multiple sidehole infusion catheters with 20 cm infusion lengths were then positioned with their superior ends at the ilio-caval junction and the distal ends in the femoropopliteal system bilaterally for overnight tPA infusion with the patient in the intensive care unit (ICU) for monitoring.

The following day, the patient returned to the procedure suite and contrast injection demonstrated near complete lysis of the bilateral ilio-caval and femoropopliteal systems (Figure 5). A resistant focal thrombus was identified in the right external iliac vein. A 6 Fr Angiojet catheter was then used to attempt thrombectomy of this focal thrombus with multiple passes of the device in this region. Venography showed minimal improvement. Therefore, an Arrow-Terrotola (Arrow International Inc, USA) device was used in an effort to break up and extract the clot, but again there was minimal improvement following this manoeuvre. Venography further demonstrated filling of the azygos and hemiazygos collaterals to the right atrium without opacification of the suprarenal IVC. A 5 Fr catheter and hydrophilic guidewire were then passed through the focal occlusion at the level of the renal veins and contrast injection revealed a patent suprarenal IVC with flow through three vessels, two of which were intrahepatic venous collaterals emptying into the right atrium; the third was likely the intrahepatic IVC (Figure 6). Next, angioplasty of the focal occlusion at the renal level of the IVC was performed with a 10 mm × 4 cm balloon. Venography at this point demonstrated direct flow through the IVC into the right atrium with decreased filling of the collaterals at the renal vein level. tPA was discontinued and the patient continued on a heparin drip. The patient was then transferred to the CT scan suite with the guidewire in place through the IVC and right atrium to ascertain whether the superior vena cava was traversed and therefore safe for angioplasty at a larger diameter, and was not just another intrahepatic collateral pathway. A CT scan demonstrated the course of the guidewire to be through the normal course of the intrahepatic IVC and adjacent to calcification that was noted at the level of the stenotic intrahepatic IVC (Figure 7). The patient was then returned to the ICU for continued monitoring.

Figure 5) Status post overnight tissue plasminogen activator with near complete lysis of femoropopliteal (A), iliofemoral (B) and iliocaval (C and D) systems

The following day, the patient was again returned to the procedure suite and placed in the supine position. Via the right common femoral vein access, with a micropuncture technique, contrast was injected and revealed complete resolution of the previously noted right external iliac vein thrombus. The IVC stenosis at the renal level was dilated again, this time with a 14 mm diameter balloon (Figure 8), with venography demonstrating decreased filling of the collaterals at the renal level, but continued filling of the intrahepatic collaterals (Figure 9). A 14 mm angioplasty was then performed on the intrahepatic IVC and completion venography demonstrated flow through

Figure 6) The intrahepatic inferior vena cava (single arrow) and the intrahepatic venous collaterals (double arrows)

Figure 7) Guidewire through the normal course of the intrahepatic inferior vena cava (IVC) (arrows) and adjacent to calcification noted at the level of the stenotic intrahepatic IVC

the intrahepatic IVC, with continued filling of the intrahepatic venous collaterals (Figure 10). Because it was believed that the IVC diameter might not accommodate a larger balloon, the procedure was terminated at this point.

Before discharge from the hospital, the patient was started on oral anticoagulation with warfarin and continued on enoxaparin until the international normalized ratio was in the therapeutic range. Hypercoagulability workup was significant for a decrease in protein S functional assay. The patient was discharged to a short-term rehabilitation facility and has since returned to active duty on the police force. Nearly two months after his procedure, a follow-up inferior vena cavogram demonstrated continued patency of the IVC and iliac veins (Figure 11). Mild narrowing at the angioplasty site at the renal vein level was again identified, but not significantly changed from the

Figure 8) Balloon angioplasty of inferior vena cava stenosis at the renal level

Figure 9) Decreased filling of the collaterals at the renal level and continued filling of the intrahepatic collaterals after angioplasty

previous inferior vena cavogram. The appearance of the intrahepatic IVC and the adjacent collaterals was unchanged (Figure 12).

Approximately one year later, the patient underwent a CT scan of the abdomen with contrast, due to transient complaints of tingling in the back and bilateral lower extremities. This study demonstrated a widely patent IVC, iliac veins and femoral veins with unchanged collateral pathways between the supra- and infrarenal IVC via the right hepatic vein collaterals. On a subsequent follow-up visit, the patient was asymptomatic and continued to be on active duty.

DISCUSSION

Deep vein thrombosis (DVT) can result in significant morbidity and mortality for affected patients. First-time diagnosis of venous thromboembolic disease occurs in approximately one in 1000 people every year in the United States and increases

Figure 10) Flow through the inter-renal segment with minimal collateral filling and continued collateral filling of the hepatic veins after angioplasty of hepatic inferior vena cava stenosis

Figure 11) Two-month follow-up vena cavogram with patent inferior vena cava and iliac veins

Figure 12) Mild narrowing of the angioplasty site at the renal level. Patent intrahepatic inferior vena cava with unchanged collaterals

exponentially with age (1). Men are slightly more likely to develop DVT and at least one-third of patients with DVT will manifest a pulmonary embolus. Recurrence rates, despite being on an anticoagulation regimen, are approximately 5% to 7% annually after an initial episode (1,2). From 1979 to 2005,

vena cava thrombosis was diagnosed in 99,000 hospitalized patients; most cases were not associated with other sites of venous thrombosis (3). Predisposing factors for the development of venous thrombosis in the extremities and vena cava alike include hypercoagulable states, stasis of blood flow and endothelial damage. Congenital stenotic lesions of the IVC are rare events and are usually found at the diaphragm or intrahepatic IVC level (4). Thrombosis of the IVC can be attributed to a variety of different causes, including neoplasms such as renal cell carcinoma, which can invade the IVC with an intraluminal extension of tumour, as well as tumours that cause extrinsic compression. Other IVC thromboses can be the result of extraluminal obstruction by retroperitoneal pathologies such as aortic aneurysms, hematomas, abscesses or in situ thrombosis secondary to iatrogenic manipulation, such as placement of catheters or IVC filters (5,6).

Complications of DVT include recurrence, pulmonary embolism and post-thrombotic syndrome (PTS), which can result in significant chronic adverse effects. PTS can lead to signs such as extremity heaviness, pain, paresthesia that is worse with activity, and symptoms such as edema, hyperpigmentation and ulcerations (7). PTS is thought to arise from damaged venous walls, luminal obstruction and incompetent venous valves. The incidence of PTS can range from 20% to 50% of patients, with most developing the syndrome within one to two years of being diagnosed with acute DVT (2,7). Variables that may predict a worse long-term outcome include patients with signs and/or symptoms of PTS within one month of diagnosis with acute DVT, previous ipsilateral venous thrombosis, obesity and older age (8).

Although anticoagulation can help prevent progression of thrombus and DVT recurrence, removing the thrombus has shown promising results in reducing the debilitating consequences of chronic venous insufficiency. Catheter-directed thrombolysis (CDT) was introduced nearly two decades ago as an alternative to systemic thrombolysis, and numerous reports have demonstrated positive outcomes. Through direct lysis of the thrombus, CDT facilitates venous flow and maintenance of valve integrity, thereby decreasing ambulatory venous hypertension with subsequent reduction of developing PTS (9). Reservations about using CDT stem from a lack of prospective randomized trials, safety concerns and high cost (9,10). However, CDT should be considered for those patients with limb threat and severe symptoms, as well as for young patients at risk for chronic venous insufficiency (11). In 1995, a multi-institutional registry of 473 patients with symptomatic DVT was established to evaluate the efficacy of CDT using urokinase. The majority of the patients in the registry had acute iliofemoral DVT, with one-fifth of cases extending into the IVC. The overall patency rate was 60% at one year. Those patients who presented with acute iliofemoral DVT and were completely lysed with CDT were reported to have 85% patency at one year (12). Currently underway is a multicentre, randomized controlled clinical trial called the Catheter-directed Venous Thrombolysis in acute iliofemoral vein thrombosis (CaVenT) study (13), with the goal of evaluating the safety and efficacy of CDT plus conventional anticoagulation versus anticoagulation alone in patients with iliofemoral DVT. With a paucity of randomized studies evaluating long-term effects of CDT, the CaVenT trial aims to evaluate the prevalence of PTS

at two years in addition to short-term patency rates at six months. However, PTS can occur many years following an acute DVT and, therefore, longer term follow-up would be necessary to fully assess the long-term effects of CDT.

Percutaneous mechanical thrombectomy and pharmacomechanical thrombectomy (PMT) are additional techniques available to reduce thrombus burden. Mechanical thrombectomy has become an important adjunct to CDT. Alone, percutaneous mechanical thrombectomy is less effective at removing venous thrombosis but, when combined with CDT, it can help reduce clot burden, increase the surface area exposed to lytic agents, and reduce the duration, quantity and potential side effects of thrombolytic agents required to successfully remove the thrombus (14,15). However, disadvantages include potential venous wall and valve injury (14). PMT incorporates the benefits of both thrombolytic agents and mechanical thrombectomy. A modification of PMT, as described with the power pulse technique, involves bathing the thrombus in lytic agents before extraction. Advantages of this method include avoiding prolonged thrombolytic infusion, less procedure time and fewer trips to the angiography suite (16). In a study involving 93 patients, comparison was made between CDT and PMT for treatment of symptomatic lower extremity DVT. In the end, PMT had similar success compared with CDT, but with reduced ICU and total length of stay, as well as decreased hospital costs (17). Progressive balloon dilation angioplasty and stenting are further treatment options in acute and/or chronic venous thrombosis, as well as stenotic lesions of the lower extremities (10,18,19). However, long-term patency rates after angioplasty involving large central veins have been suboptimal due to low flow, fibrosis and vessel recoil. This can be prevented with stenting, leading to improved patency rates (20).

The long-term complications from PTS and chronic venous insufficiency can be devastating to the afflicted patient. Although anticoagulation has been the conventional method of treatment, the benefit of removing the thrombus burden cannot be underestimated. CDT and mechanical thrombectomy do not come without risks, but in a select group of patients, these interventions have the potential to provide long-term benefits. Although larger, prospective, randomized trials are needed to change conventional practice, advances in endovascular techniques have already shown promising results for reducing the morbidity associated with DVT.

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