Mesenteric venous thrombosis (MVT) is an uncommon condition associated with significant mortality and morbidity, due in part to nonspecific presentations and frequent delays in diagnosis. The traditional management has been medical treatment with anticoagulation. Surgery is reserved for patients who have failed medical therapy or who present with signs of mesenteric ischemia. Endovascular intervention utilizing percutaneous mechanical thrombectomy (PMT) and thrombolysis provides an attractive alternative that is less invasive with minimal complications. We describe a patient with symptomatic MVT who was successfully treated with a percutaneous transhepatic approach. Several endovascular techniques were utilized to achieve the optimal result.

CASE STUDY

A 45-year-old woman presented with a 48-hour history of severe abdominal pain. Her medical history was only significant for her 17-year history of oral contraceptive usage. Initial laboratory evaluations, including arterial blood gas, complete blood cell counts, liver function tests, amylase, and lipase were unremarkable except for a mildly elevated white blood cell count of 13,000. On physical examination, she was tender to palpation at the right upper quadrant and epigastric area. Abdominal ultrasound showed a normal-appearing gallbladder without wall thickening or pericholecystic fluid. Abdominal CT scan demonstrated thrombosis of the portal vein (PV) and superior mesenteric vein (SMV) without evidence of extrinsic compression (Figure 1). An evaluation for hypercoagulable states, including protein C and S, homocysteine, factor V Leiden, antithrombin, prothrombin mutation 20210, fibrinogen, lupus anticoagulant, and anticardiolipin antibody did not reveal any abnormality. Due to her acute symptoms and extensive thrombus, we decided to proceed with PMT and thrombolysis via a transhepatic approach.

Under ultrasound guidance, a tributary of PV was identified along with branches of bile duct and hepatic artery (Figures 2 and 3). The PV tributary was accessed using the standard Seldinger technique followed by advancing an angled Glidewire (Terumo Medical Corporation, Somerset, NJ) to the SMV. Once the access to the PV was secured with a 7-F guiding sheath, a 5-F tapered angled Glide catheter (Terumo) was tracked over the wire to the distal SMV. Initial angiography through the angled Glide catheter demonstrated occluded PV, proximal SMV, and splenic vein (Figure 4). Two mg of tPA (tissue plasminogen activator, Genentech, South San Francisco, CA) was infused into the occluded vessels followed by PMT using a 6-F AngioJet rheolytic catheter (Possis Medical, Inc., Minneapolis, MN) and subsequent balloon angioplasty with an 8-mm balloon. Upon completion of the procedure, antegrade venous flow was observed in the portal and SMV systems.

Figure 1. An abdominal CT scan revealed a thrombosed portal vein (long arrow) (A) and a thrombosed SMV (short arrow) (B).
the mesenteric system. A multihole infusion catheter was then placed in the SMV, and overnight tPA infusion at the rate of 0.5 mg/h was continued for treating residual thrombus within the lumen. The next day, the patient’s symptoms were improved, and her abdominal pain had subsided. Nonetheless, due to angiographic evidence of sluggish flow and residual thrombus, we proceeded with another trial of AngioJet PMT followed by overnight thrombolysis with tPA at the infusion rate of 1 mg/h. The repeat venography was performed the next day, showing dramatically improved flow and patent PV and SMV (Figure 5). The sheath and the catheter were subsequently removed, and the catheter tract was embolized with coils (Terumo) and packed with Gelfoam (Pfizer, New York, NY) to achieve hemostasis. The patient was discharged home 3 days later on oral warfarin and remained symptom-free 1 year later. The oral contraceptive has since been discontinued.

**DISCUSSION**

MVT accounts for 5% to 15% of acute mesenteric ischemia and is associated with multiple factors, including sluggish flow as in patients with portal hypertension or congestive heart failure (CHF), endothelium damage as in patients with visceral infection or trauma, and hypercoagulable state as in patients with malignancy or hematological disorders. Oral contraceptives are known to induce a hypercoagulable state and are associated with thrombotic phenomena in multiple sites including the mesenteric vein. As demonstrated in our patient, extensive laboratory evaluations of her hypercoagulable state were unremarkable, and a CT scan did not reveal any evidence of extrinsic compression. The only identifiable contributing factor was her prolonged history of oral contraceptive usage, which we postulated was the primary cause of MVT in our patient.

Acute MVT is traditionally treated with systemic anticoagulation using heparin and warfarin to prevent propagation of thrombus in a stable patient. Brunaud reviewed 26 patients with acute MVT over 12 years and compared the outcomes between surgical intervention and medical therapy. They concluded that the morbidity, mortality, and survival rates were similar in both groups with a 2-year survival rate of 76.9%. A nonoperative approach avoids unnecessary resection of the small bowel that may be potentially reversible with anticoagulation alone. However, despite early anticoagulation therapy, transmural infarction can occur in up to 18% of patients with acute MVT. Surgery is warranted once any sign of clinical deterioration developed during the period of observation or on initial presentation. Even with prompt surgical intervention, the patients who presented with compromised bowel still have significant mortality rates up to 80%, and recurrent bowel infarction occurs in nearly 30%.

Endovascular intervention offers an attractive therapeutic alternative that is minimally invasive and associated with relative low morbidity and mortality. There are several approaches reported in the literature including indirect intra-arterial infusion of a thrombolytic agent through the superior mesenteric artery, transjugular portal vein access, and direct transhepatic portal vein puncture. Transarterial approach is the most indirect route and provides the least reliable doses of thrombolytic agents that reach the mesenteric venous system due to preferential flow to the collateral vessels. Both transjugular and transhepatic approaches provide direct access to the portal vein, through which various endovascular techniques can be utilized. In addition, local infusion of thrombolytic agents in both transhepatic and transjugular approaches provides more predi-
cable and relatively rapid resolution of thrombus. Moreover, using a lower dose of thrombolytic agents with a direct approach tends to reduce the incidence of bleeding complications compared to systemic thrombolysis using the transarterial approach. Comparing the two direct approaches of transjugular and transhepatic, transjugular access is more technically challenging, particularly for patients with a thrombosed PV. Conversely, using ultrasound guidance for the transhepatic approach, PV tributaries can be easily visualized in experienced hands. As demonstrated in our patient, the PV tributary was undoubtedly identified along with branches of the hepatic artery and bile duct.

Multiple endovascular techniques, including AngioJet PMT and thrombolysis, balloon angioplasty, and stent placement, were used for our patient to achieve optimal clinical response. PMT has the advantage of rapidly removing thrombus and shortening the duration of thrombolytic infusions. Therefore, it reduces the potential for bleeding complications. We also used balloon angioplasty and pharmacological thrombolysis to achieve a satisfactory result. Admittedly, the potential drawback of PMT and angioplasty is intimal trauma, which may promote recurrent thrombosis. Bilbao et al observed two patients who experienced partial rethrombosis. Our patient received heparin anticoagulation followed by long-term warfarin therapy to prevent recurrent thrombosis.

Due to the rarity of acute MVT, there is paucity of data describing long-term outcomes of endovascular interven-

tions. Most exiting reports in the literature are of patients with posttransplant MVT. Cherukuri successfully treated two patients using a transhepatic endovascular approach and reported a 100% patency rate at 2.5 years and 4.5 years after the procedures. Lopera and his colleagues also successfully treated three patients with symptomatic acute MVT and achieved a good clinical outcome up to 36 months. Recently, Kim et al reviewed their experience of percutaneous catheter-directed thrombectomy and thrombolysis for SMV thrombosis. They, too, concluded that PMT/thrombolysis was associated with low incidences of morbidity and mortality over a mean follow-up of 42 months. Although there are increased clinical reports, the long-term data on PMT and thrombolysis are still lacking. Therefore, diligent long-term follow-up is warranted.

CONCLUSION
The transhepatic endovascular approach provides a safe and effective alternative to traditional therapy. It has the advantage of rapid thrombus resolution and potential prevention of MVT-associated bowel ischemia. Furthermore, a combined PMT and thrombolysis approach reduces the risk of bleeding by decreasing the dose and duration of thrombolytic infusion. Our case provides a valuable addition to this small literature collection and underscores the value of using multiple endovascular techniques to treat this potentially life-threatening condition.

(Continued on page 46)
CHALLENGING CASES

(Continued from page 38)
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