Management of hepatic caval stenosis and obstruction with modified Gianturco Z-stents

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ABSTRACT

Hepatic caval stenosis is managed with stenting; however, stent placement can be complicated by migration, which can be life-threatening. The risk of migration can be mitigated by increasing the length of the stent, which increases contact with the vessel wall. We describe the cases of three patients with hepatic caval stenosis treated with two Z-stents sutured together. Each had an uncomplicated postoperative course and demonstrated clinical improvement. The use of sutured Z-stents can increase the stability of the stent and, therefore, decrease the morbidity associated with stent placement for hepatic caval stenosis. (J Vasc Surg Cases Innov Tech 2023;9:101287.)

Keywords: Budd-Chiari syndrome; Inferior vena cava; Self-expandable metallic stents; Stents

Hepatic caval stenosis can arise from several etiologies, the most common of which are compression by malignant or benign masses and postoperative anastomotic strictures.[1,2] Patients can present with lower extremity edema, lower limb venous thrombosis, and recurrent ascites. Caval venous occlusive disease can be managed effectively with angioplasty and stent placement; however, stent placement can be complicated by migration, which occurs at an estimated rate of between 0.4% and 4.5% and can be life-threatening if involving the right atrium, right ventricle, or pulmonary artery.[3-8] This report describes three cases of intrahepatic caval stenosis in which two Gianturco Z-stents were sewn together in tandem to extend the total stent length, decrease the likelihood of migration, and maintain the inflow from the hepatic veins. The present patients provided written informed consent for the report of their case details and imaging studies.

CASE REPORT

Patient 1. A 33-year-old woman with a history of sarcomatoid liver carcinoma in hepatic segment 1 was admitted to our institution with a 3-day duration of abdominal pain, somnolence, nausea, and recurrent syncope after the initiation of chemotherapy. Laboratory studies revealed mild lactic acidosis with elevated liver enzymes. Computed tomography (CT) revealed occlusion of the intrahepatic inferior vena cava (IVC) with suspected stenosis or occlusion of the right and middle hepatic veins, resulting in hepatic venous congestion (Fig 1). Initial venography confirmed stenosis of the right hepatic vein confluence (Fig 2).

Diagnostic venography and endovascular stent placement with the patient under general anesthesia was pursued. Access was achieved in both common femoral veins and the right internal jugular vein to obtain through-and-through access. Inferior vena cavography was performed via common femoral vein access to characterize the length and location of the stenosis. Intravascular ultrasound (IVUS) of the IVC was pursued through a femoral sheath. The Z-stents were oversized by ≥2 mm from the suprarenal caval measurement to prevent migration. Initial angioplasty of the suprarenal cava was performed using an 8-mm × 80-mm Charger balloon (Boston Scientific).

The right internal jugular vein sheath was upsized to a 20F × 33-cm DrySeal introducer sheath (W.L. Gore & Associates) and advanced to the site of stenosis. The 16F Z-stent nonvalved sheath was advanced over the same guidewire from the neck (Fig 3). Next, two Gianturco Z-stents (Cook Medical) were loaded onto the wire after the 16F sheath. The stents were partially exposed from their peel-away sheaths, and the ends were sutured together with 3-0 Prolene suture (Ethicon; Fig 4). Using the pusher, the stents were advanced into the 16F sheath, which was then telescoped through the 20F sheath. Under fluoroscopic guidance, the Z-stents were then deployed at the site of stenosis. Two 20-mm × 50-mm stents were used.

The freshly placed stents were postdilated with a 14-mm × 40-mm Atlas balloon (Becton Dickinson). The balloon was not insufflated beyond the nominal pressure to avoid suture disruption. Venography showed reestablishment of the caval lumen with brisk flow toward the right atrium. However, sluggish flow was present throughout the right hepatic vein. IVUS showed rouleaux formation, suggestive of stenosis between the right hepatic vein and IVC. A 14-mm × 80-mm Abre stent (Medtronic)

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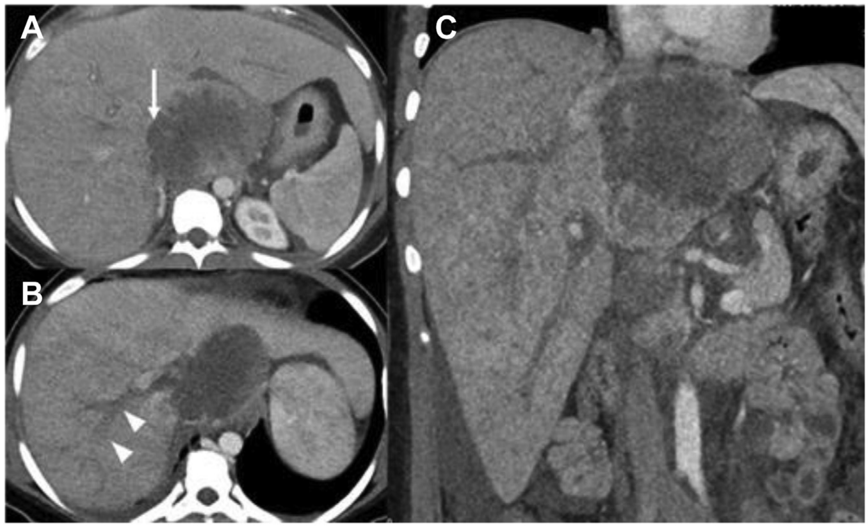

Fig 1. Preoperative computed tomography (CT) scan with axial **(A, B)** and coronal **(C)** reformatted images of a 33-year-old woman with sarcomatoid liver carcinoma resulting in hepatic inferior vena cava (IVC) occlusion (*arrow*) and compromised outflow of the right hepatic vein (*arrowheads*). Hepatic congestion was noted throughout the liver, suggestive of Budd-Chiari syndrome.

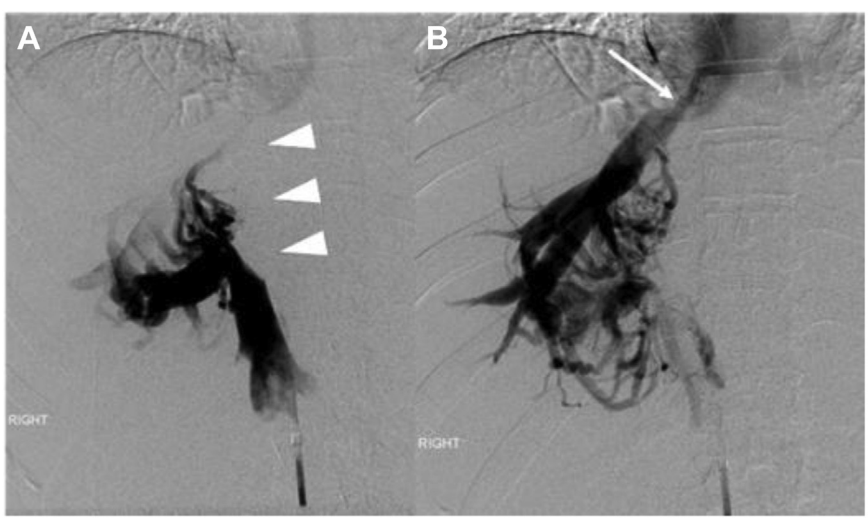

Fig 2. Initial venogram in early **(A)** and delayed **(B)** phases demonstrating long segment occlusion of the hepatic inferior vena cava (IVC; *arrowheads*) and confirmed stenosis of the right hepatic vein confluence with numerous dilated intrahepatic collateral vessels from an accessory right hepatic vein.

was deployed from the right hepatic vein into the IVC, which improved flow on both venography and IVUS. The operative time was 182 minutes, with 125 mL of contrast used and a fluoroscopic time of 53.3 minutes.

The patient had an uncomplicated postoperative course. She was treated with radiation therapy and adjuvant chemotherapy for the sarcomatoid tumor, which had decreased in size on postoperative CT at 6 months after intervention (Fig 5). The patient was deemed a surgical candidate and underwent successful extended left hepatectomy with en bloc resection of the vena cava and reconstruction using a PTFE (polytetrafluoroethylene) graft.

Patient 2. A 72-year-old woman with a history of IVC compression by numerous hepatic cysts presented with recurrent lower extremity edema. She had been previously treated with thrombolysis and IVC filter placement and multiple sessions of cyst aspiration and sclerosis. Initially, she had presented to an outside institution with cramping and swelling of the lower extremity. At the outside institution, CT was performed and demonstrated evidence of venous thrombosis 7 years after her initial episode of venous thrombosis. She was referred to our institution for further evaluation and management.

Diagnostic venography and endovascular stent placement with the patient under general anesthesia was pursued.

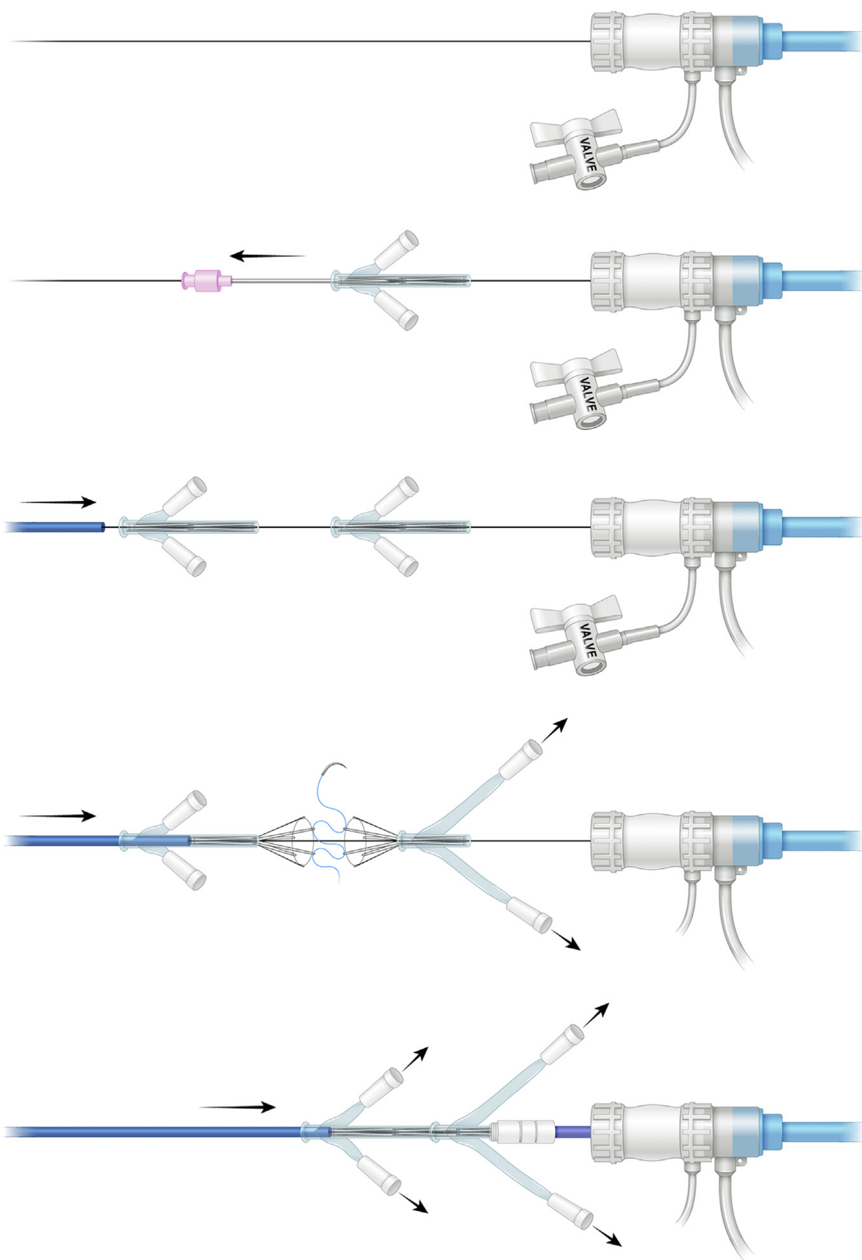

Fig 3. Illustration of tandem Z-stent suturing over a guidewire.

Through-and-through access was achieved, and inferior vena cavography was performed to characterize the length and location of the stenosis. The IVC was evaluated with IVUS, which showed effacement of the IVC by adjacent hepatic cysts with a 2 mm minimum diameter. The Z-stents were oversized by ≥2 mm from the suprarenal caval measurement to prevent migration.

Two 20-mm × 50-mm Z-stents were sutured together and deployed in a fashion similar to that for patient 1. The stents were postdilated with a 20-mm × 40-mm Atlas balloon. IVUS confirmed improvement of the caliber of the lumen from 2 mm to 16 mm.

Pressure measurements were taken both before and after deployment of the stents. The patient exhibited a 1-mm Hg reduction in the pressure gradient after stent placement. The reason for this small difference in the pressure gradient is unclear, although stent placement resulted in appropriate transmitted pulsatility from the right atrium, which had been absent before stent placement. The operative time was 121 minutes, with 65 mL of contrast used and a fluoroscopic time of 13.9 minutes.

The patient had an uncomplicated postoperative course. She continued to experience leg heaviness and edema and underwent repeat stenting, after which her symptoms improved.

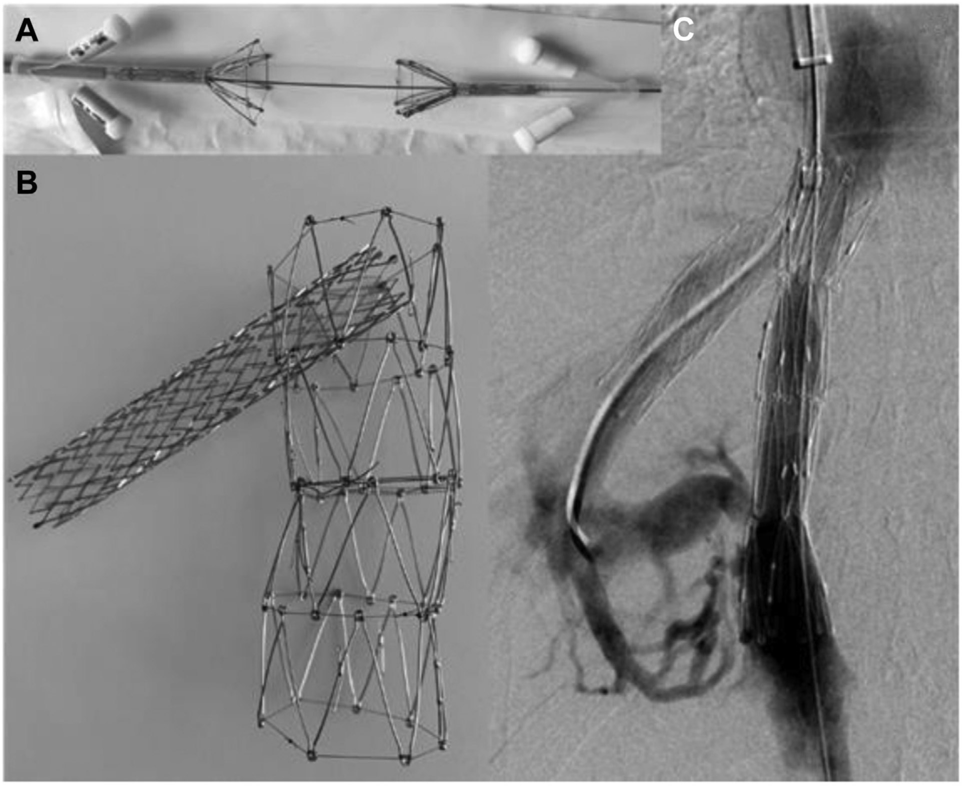

Fig 4. Two Gianturco Z-stents were sutured together after preloading on an exchange length guidewire. The stents were partially exposed from the deployment sheaths **(A)** and sutured together with 3-0 Prolene suture. **(B)** A second stent was placed in the hepatic vein through the more rostral Z-stent interstices. **(C)** Right hepatic vein and hepatic venous flow improved after intervention.

Patient 3. A 39-year-old woman with a history of liver transplant secondary to nonalcoholic steatohepatitis cirrhosis experienced persistent renal failure after transplantation that was thought to be indicative of hepatorenal syndrome. Inferior vena cavography demonstrated severe stenosis at the caval anastomosis. Elevated pressures in the infrahepatic IVC were suggestive of intrahepatic stenosis. Diagnostic venography and endovascular stent placement with the patient under general anesthesia were pursued. Through-and-through access was achieved, and inferior vena cavography was performed to characterize the length and location of the stenosis. The IVC was evaluated with IVUS, which revealed a cross-sectional area of 3 mm × 10 mm at the area of the most severe stenosis. The Z-stents were oversized by ≥2 mm from the suprarenal caval measurement to prevent migration.

Two 25-mm × 50-mm Z-stents were sutured together and deployed in a fashion similar to that used for the previous patients. The stents were postdilated with a 14-mm × 40-mm Atlas balloon. IVUS demonstrated improvement in the caliber of the lumen at the site of the most severe stenosis to 12 mm × 12 mm. Pressure measurements taken both before and after deployment of the stents revealed a 4-mm Hg reduction in the pressure gradient after stent placement. The operative time was 100 minutes, with 125 mL of contrast used and fluoroscopic time of 11.2 minutes.

Her postoperative course was uncomplicated. The patient was weaned off dialysis within 3 weeks after stent placement and remained asymptomatic for the subsequent 18 months.

DISCUSSION

Hepatic caval stenosis often results from tumoral compression or trauma or as a complication of liver transplant surgery.[1,2] Venoplasty and stent placement can relieve the obstruction and improve symptoms. Stent migration is a rare, but serious, complication. Most reported cases of stent migration occur with smaller diameter and shorter stents, suggesting that the length and diameter play a role in stent stability within the vessel.[9] If migration occurs, removal of the stent will sometimes be necessary to reduce the risk of thrombosis and vessel trauma.[5] If migration of the stent has occurred into the right atrium, endocardial injury, arrhythmia, and injury to valves can occur.[4-8,10,11] In some cases, these stents can be removed using endovascular techniques; however, open surgery can be required to remove the migrated stent, which is associated with significant morbidity.[12] Multiple cases have reported mortality related to stent migration to the heart.[8] To monitor for delayed stent migration, patients at our institution are followed up with surveillance venography

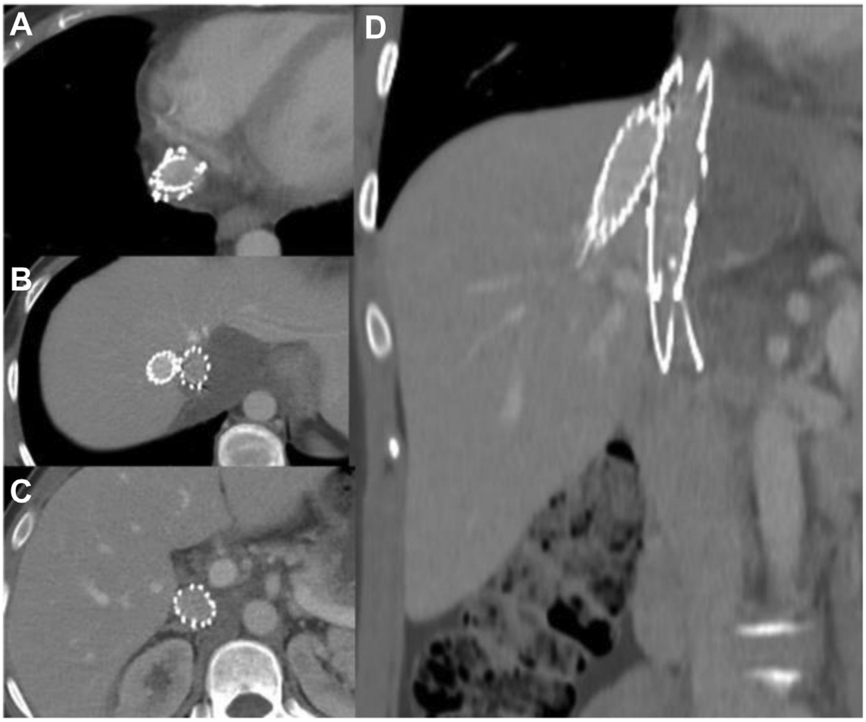

Fig 5. On axial reformatted images **(A-C)** and coronal image **(D)** of computed tomography (CT) at 6 months after intervention, the stent apparatus was patent and the hepatic congestion had resolved. The sarcomatoid carcinoma had reduced in size with adjunctive therapy and was later resected.

every 3 to 6 months for 1 to 2 years if the primary pathology is benign disease. Patients with malignant disease are followed up with serial CT scans as part of oncologic follow-up. Surveillance venography is performed for these patients as needed.

The use of overlapping Z-stents is a possible treatment of central venous stenosis of both compressive and obstructive pathologies. However, their fixed length limits their utility when treating extrinsic stenosis >5 cm. In these situations, stents can migrate cranially or caudally such that the area of worst stenosis becomes situated between the two stents.[13,14] Using this technique, the length of the stent construct can bridge the entirety of the stenosis with a single stent unit and greater contact with the vessel wall. The use of this technique decreases the risk of stent migration, in particular, toward the right atrium. The stents are deployed from the internal jugular access to anchor the stents in the nondiseased suprarenal cava. The wide interstices and overall low metal surface area of the Z-stent prevent significant coverage of the hepatic vein inflow and can allow for placement of a hepatic vein stent through the interstices, if necessary. Additionally, the barbs present on Z-stents facilitate fixation and provide appropriate radial force to overcome even malignant obstructions. Similarly, by suturing the two Z-stents together, the operator can obviate the need for multiple overlapping stents to cover the lesion length. Balloon angioplasty was performed in each case to achieve adequate stent expansion. In all cases, no evidence of suture disruption was found. This strategy is not in accordance with the typical Z-stent instructions for use but has been used in the setting of no other available options.

CONCLUSIONS

In the present report, we detail the use of two Z-stents sutured together to successfully treat hepatic caval stenosis. The use of the Z-stent in this fashion helps to avoid stent migration and the morbidity associated with this complication.

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