Inferior Vena Caval Stenting

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Inferior vena caval stenosis after liver transplantation is an uncommon complication that may present with lower extremity edema or ascites. Angioplasty and stenting offer a rapid, minimally invasive therapy for inferior vena caval stenosis. A variety of metallic stents have been used to successfully alleviate caval strictures including Wallstents (Boston Scientific, Natick, MA) and Gianturco-Rosch tracheobronchial Z-stents (Cook, Inc., Bloomington, IN).¹⁻³ The latter are attractive because they possess high radial strength, exhibit minimal foreshortening and have large interstices.

COMPLICATION

A 47-year-old woman who had received a liver transplant 1 year earlier was referred to our Vascular and Interventional Radiology section for treatment of an inferior vena cava stenosis. On physical exam, she had had massive leg swelling and pain. Our plan was to perform angioplasty with possible stent insertion.

The right internal jugular vein was punctured using ultrasound guidance and a pigtail catheter was advanced into the inferior vena cava. Cavography was performed revealing a smooth, tapered stenosis of the intrahepatic inferior vena cava (Fig. 1A). Pressure measurements obtained across the stenosis revealed a gradient of 22 mm Hg. The pigtail catheter was exchanged over a rigid guidewire (Amplatz super stiff, Boston Scientific, Natick MA) for an 18 mm × 20 mm angioplasty balloon catheter (XXL, Balloon dilation catheter, Boston Scientific, Natick, MA) that was used to dilate the lesion. Repeat cavography revealed minimal improvement and the pressure gradient across the narrowed segment remained at 20 mm Hg. Due to the elastic recoil of the lesion, we elected to attempt stent insertion.

A 16 French 40 cm long vascular sheath (Check-Flo II Introducer Set, Cook) was inserted over the

guidewire after serial dilation of the puncture site in the neck. The distal aspect of the sheath was positioned at the caudal aspect of the caval stenosis. The dilator included with the sheath was modified to function as a pusher by cutting the tapered end. A 25 × 50 mm modified Gianturco Z-stent was inserted into the sheath and advanced toward the stenosis. As the stent neared the lower portion of the sheath, trailing end spontaneously expanded in the right atrium (Fig. 1B). Deducing that the sheath had ruptured, we cleansed the right groin and obtained venous access via the common femoral vein. A 25 mm Amplatz Goose Neck Snare (Microvena, White Bear Lake, MN) was used to engage the distal portion of the guidewire and the wire was pulled out of the sheath to secure through-and-through access.

The snare was then advanced over the guidewire and around the distal aspect of the right internal jugular vein sheath. Attempts to encircle the expanded portion of the stent in the right atrium were unsuccessful. Thus, the snare was closed over the portion of the sheath immediately caudal to the deployed portion of the stent to prevent further propagation of the rent. The entire sheath, stent, and snare combination was advanced across the cavo-atrial junction into the inferior vena cava (Fig. 1C). The patient was awake during the procedure and reported no pain during this maneuver.

The snare was opened and retracted below the internal jugular vein sheath. The pusher was then used to buttress the trailing end of the stent and the right internal jugular vein sheath was slowly pulled cephalad from the puncture site in the neck to propagate the rent to the distal end of the sheath. Once the rent was fully extended to the distal aspect of the sheath, the leading portion of the stent expanded in the inferior vena cava. The ruptured sheath was then exchanged for a new identical sheath. Inspection of the sheath revealed a

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Figure 1 Sheath rupture during inferior vena caval stent insertion. (A) Digital subtraction venogram shows smooth tapered stenosis of the intrahepatic inferior vena cava. The gradient across this stenosis was 22 mm Hg. (B) Fluoroscopic image showing trailing end of the Z-stent partially expanded into the right heart. Note distal end of sheath in the inferior vena cava. (C) Fluoroscopic image shows snare encircling distal end of sheath. The entire unit was then advanced into the inferior vena cava. (D) Final digital subtraction venogram shows two overlapping Z-stents and improvement in caval stenosis. Gradient across the stents was 8 mm Hg.

linear tear from the rupture site to the distal end. Because the stent was suboptimally positioned a second 25×50 mm Z-stent was deployed uneventfully through the new sheath to fully cover the stenotic segment of the inferior vena cava (Fig. 1D). The gradient across the stents was reduced to 8 mm Hg. An echocardiogram performed after the procedure revealed no evidence of hemopericardium and the patients leg symptoms improved in the ensuing week.

DISCUSSION

Several researchers have reported experience using metallic stents to treat inferior vena caval stenosis.¹⁻³ Most researchers have used self-expanding stents such as the Wallstent or Z-stent. We currently favor the Z-stent for several reasons. First, there is minimal foreshortening enabling precise placement. This is particularly important for upper caval stenosis near the cavo-atrial junction. Since the stent migrates forward slightly during deployment, we generally deploy the stent from the right internal jugular vein to prevent migration into the right heart. Second, the Z-stent has more radial force than the Wallstent making it particularly well-suited for caval strictures. Third, it has larger interstices than the Wallstent and is therefore ideal for upper caval stenoses when the stent must extend across the hepatic vein orifice. We have treated patients using inferior vena cava Wallstents who have developed hepatic venous outflow obstruction as intimal hyperplasia forms on the Wallstent. This has not occurred in patients we have treated with Z-stents. Finally, the Z-stent has anchoring hooks preventing migration. Wallstents lack fixation and may migrate during deployment (i.e., "watermelon seed" or "toothpaste"), particularly when deployed across a short, focal severe stenosis. In one case report, a gastropepy T-fastener was necessary to secure the stent in place.⁴ One disadvantage of the Z-stent compared with the Wallstent is that it must be deployed through a much larger introducer.

Reported procedural complications of metallic stents include migration and malposition.⁵ To our knowledge, this is the first report of a sheath rupture. We speculate that this complication occurred when one of the fixation hooks scored and punctured the wall of the sheath. The radial force of the stent then propagated the rent as it expanded into the right heart. To avoid this complication we currently use slightly larger reinforced sheaths. Note that the Z-stent is marketed for tracheobronchial use in the United States and the 24 Fr. Sheath used for this indication does not have a hemostatic valve. The sheath used in this report supplied from the same manufacturer is constructed of similar

material but is smaller in diameter and has a hemostatic valve.

Stent malposition into the right heart is a devastating complication that may be lethal. Prahlow et al.⁶ reported a patient who developed hemopericardium and expired after migration of a Wallstent into the heart during a transjugular intrahepatic portosystemic shunt insertion. Our attempts to recapture the stent using a snare were unsuccessful because the anchoring hooks of the Z-stent became entangled with the snare during attempts to encircle and reconstrain the stent. We had significant reservations about pushing the partially deployed Z-stent through the cavoatrial junction since the anchoring hooks could lacerate the right heart or inferior vena cava. Fortunately, we were able to advance the stent into the inferior vena cava without serious injury to the right heart. The next dilemma was what to do once the partially deployed stent was positioned in the inferior vena cava. We were able to use the pusher to buttress the trailing end of the stent and then slowly retracted the ruptured sheath to propagate the rent in similar fashion to a banana peel-away sheath. We were concerned that this maneuver may deform the stent but this did not occur. Had it been impossible to propagate the rent in this fashion, we would have used a high pressure balloon to expand the defect.

In summary, we present a case of sheath laceration during inferior vena cava stent insertion. We caution against using the sheath used in this case report.

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