Balloon-expandable covered stenting of a large right hepatic artery aneurysm

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ABSTRACT

Hepatic artery aneurysms (HAAs) are rare visceral aneurysms with a high rupture rate. We report the case of an 88-year-old man with a 4.2-cm right HAA treated with covered stenting. Balloon-expandable covered stents effectively excluded the HAA with excellent proximal and distal seals. Our case is one of a limited number of reports on successfully repairing a hepatic aneurysm with a balloon-expandable stent graft. This case demonstrates that balloon expandable covered stenting is a viable approach in patients with appropriate anatomy and may be favorable in patients precluded from open bypass. (J Vasc Surg Cases Innov Tech 2024;10:101601.)

Keywords: Hepatic artery; Aneurysm; Endovascular; Stent; Balloon expandable

Hepatic artery aneurysms (HAAs) are rare, with an incidence of 0.002% to 0.010% and a 44% rupture risk.[1-4] Current guidelines recommend intervention if an HAA is >2.0 to 2.5 cm.[4,5] Endovascular stenting is the preferred interventional strategy, but poses the risk of ischemia and infarction.[6,7] We report a case of a 4.2-cm right HAA treated with balloon-expandable covered stenting. The patient provided written consent for this publication.

CASE REPORT

An 88-year-old man with a medical history of hypertension was referred to the vascular surgery clinic for a HAA found on ultrasound examination during the evaluation of a mass concerning for renal cell carcinoma. Computed tomography angiography noted a 4.2-cm calcified fusiform aneurysm of the right hepatic artery (RHA) (Fig 1), an aberrant gastroduodenal artery (GDA) originating from the left hepatic artery (LHA), and left liver lobe atresia. The patient did not endorse abdominal pain, anorexia, bloody stools, or jaundice and his physical examination was benign. After counseling on the risks and benefits of treatment in the setting of possible renal cell cancer, the patient consented to diagnostic angiography with possible endovascular repair.[4]

He was brought to the hybrid operating room, and general anesthesia was induced. Ultrasound-guided retrograde access of the right common femoral artery was obtained with a standard micropuncture kit (Cook Medical Inc, Bloomington, IN). The patient was systemically anticoagulated with 8000 U of heparin. The sheath was upsized to an 8F Flexor High-Flex Ansel Guiding Sheath (Cook Medical Inc), and the celiac artery was engaged with a SOS Omni Selective Catheter (AngioDynamics Latham, NY) over an 0.035″ Glidewire Advantage (Terumo Medical Corp, Franklin Township, NJ). The sheath was advanced into the splenic artery and withdrawn over the wire with simultaneous injection of contrast dye to define the origin of the common hepatic artery.

Selective angiography of the common hepatic artery determined the aneurysm to originate in the RHA without LHA involvement. An aberrant GDA was noted to originate from the LHA (Fig 2, *A*). Consistent with the patient's known left lobe atresia, the RHA was noted to be the predominant supply to the liver. SMA angiography demonstrated antegrade filling of the aberrant GDA and LHA. Given these anatomical characteristics, covered stenting of the HAA with coverage of the LHA was feasible. Owing to the intricate branching vasculature, the surgical team elected to treat the lesion with balloon-expandable covered stents instead of self-expanding stents to maximize accurate stent deployment.

An 0.018″ intravascular ultrasound examination confirmed the location of the hepatic bifurcation and measured the diameter of the RHA landing zones to be 8 mm proximally and 5 mm distally, with 10 mm of healthy proximal and distal landing zone length. The 0.018″ wire was placed into a branch of the RHA and exchanged for a 0.035″ Rosen wire. A 5 × 39-mm Gore VBX balloon-expandable covered stent (W. L. Gore & Associates, Inc., Flagstaff, AZ) was deployed into the distal RHA, followed by a 7 × 19-mm VBX post dilated with a 10-mm balloon. Angiography demonstrated excellent proximal seal with a type Ib endoleak. A 5 × 19-mm VBX was deployed into the distal RHA with angiography redemonstrating the type Ib endoleak that persisted after post dilation with a 6-mm balloon.

After the VBX delivery system failed twice, the surgical team inferred that this was a result of stent migration at the distal seal zone. It was noted that the second VBX stent had retracted to the edge of the previously placed VBX. This was attributed to the distal landing zone's proximity to a bifurcation of the RHA, which caused the stent to retract as it expanded against the

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2468-4287

https://doi.org/10.1016/j.jvscit.2024.101601

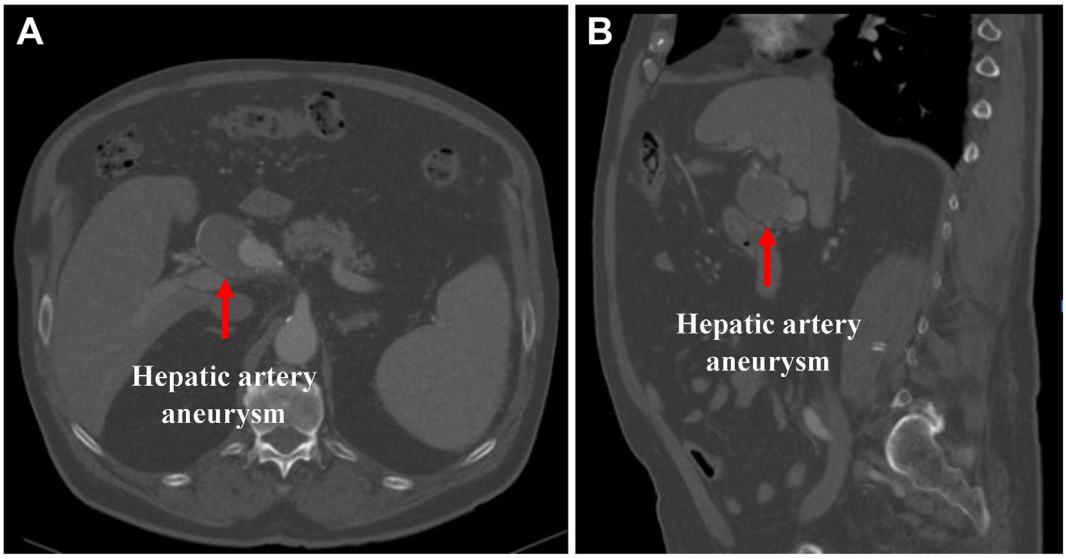

Fig 1. A 4.5-cm asymptomatic right hepatic artery (RHA) aneurysm (HAA) with bifurcation of left hepatic and gastroduodenal arteries in the **(A)** axial and **(B)** sagittal views.

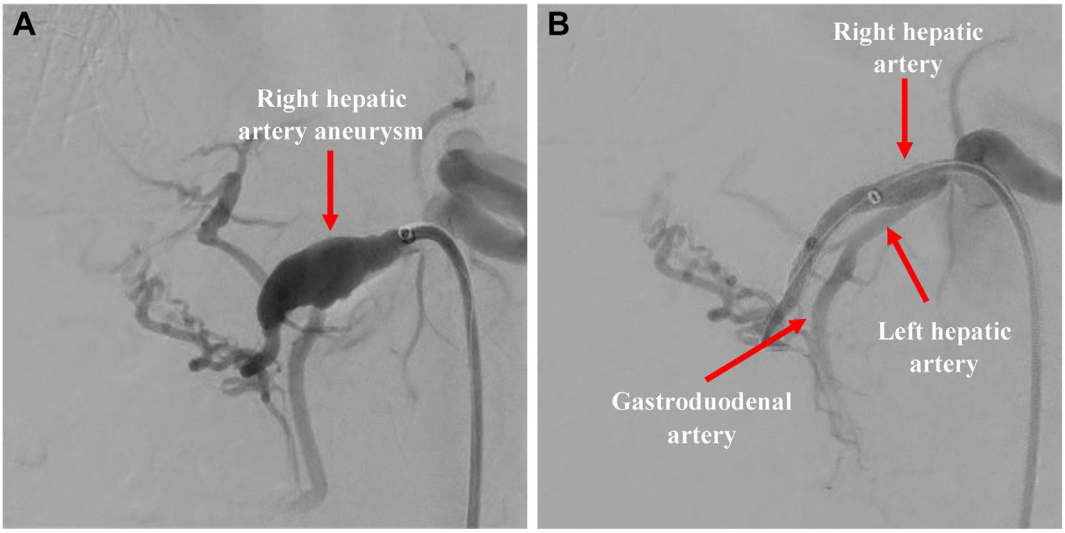

Fig 2. Angiogram **(A)** before and **(B)** after deployment of endovascular stents with exclusion of the aneurysm and filling of the right hepatic artery (RHA) and retrograde filling of the left hepatic artery (LHA) via the gastroduodenal artery.

bifurcating vessel wall. The surgical team elected to use the iCAST-covered stent system (Atrium Medical Corp, Hudson, NH). A 5 × 22-mm iCast was deployed into the distal RHA at the level of the intrahepatic branch of the RHA and post dilated with a 6-mm balloon. Angiography showed the exclusion of the right HAA with excellent filling of the RHA and the LHA via the aberrant GDA (Fig 2, *B*). The sheath was removed, and the access was managed with a Perclose Proglide device. The patient was extubated and admitted for monitoring.

On postoperative day 1, the patient's liver function tests noted an alanine transaminase of 10 U/L, aspartate transaminase of 19 U/L, and alkaline phosphatase of 107 U/L. He was discharged home on clopidogrel 75 mg and aspirin 81 mg daily. One-month computed tomography angiography demonstrated patent stents without endoleak (Fig 3). Six-month mesenteric duplex imaging noted aneurysm regression to 3.9 cm, and patent stents without stenosis or endoleak. The patient was maintained on a dual antiplatelet regimen for 12 months after the procedure to minimize the risk of stent occlusion.

DISCUSSION

The management of HAAs is highly patient specific. Factors to consider include the risk of rupture, location of the aneurysm, sufficient collateralization, and open

Fig 3. Computed tomography angiography in the axial view at 30 days after the procedure demonstrating patent right hepatic artery (RHA) stents.

surgical risk.[4,8-10] The most common treatment options include stenting, coil embolization, and open bypass.[11-13] Endovascular repair is favored over open surgery owing to decreased morbidity and faster recovery.[4,5] In this patient with an RHA-dominant liver supply and an aberrant GDA originating from the LHA, endovascular-covered stenting was feasible.

Stenting has a lower risk of infarction and abscess formation compared with embolization, but differences in the proximal and distal seal zone diameters can exclude certain patients. High-quality imaging is critical to selecting the best intervention.[4] The angiogram of our patient noted RHA dominance with an aberrant GDA off the LHA, which would provide retrograde profusion should the LHA be covered. This informed our decision to pursue stent placement. Intravascular ultrasound examination served as secondary confirmation for the feasibility of stent repair and allowed accurate assessment of the seal zones of the stent.

There are limited reports on balloon-expandable covered stenting of visceral aneurysms.[14] Balloon-expandable stents confer a theoretical advantage in repairing visceral vessels by increasing deployment accuracy, wall apposition, and luminal diameter by exerting a high radial force that decreases intrinsic stent recoil.[15-17] However, the effectiveness of different stent delivery systems can vary based on anatomy. In this case, the VBX stents retracted upon deployment into the RHA, and the iCAST stent sealed the endoleak.

The authors hypothesize that this resulted from two differences in the designs of the stent delivery systems (Fig 4). First, the iCAST stent has a longer nose cone (distance from the catheter tip to stent edge), which facilitated the catheter's delivery into the bifurcating RHA branch vessel before deployment. Second, the iCAST balloon inflates asymmetrically while the VBX stent

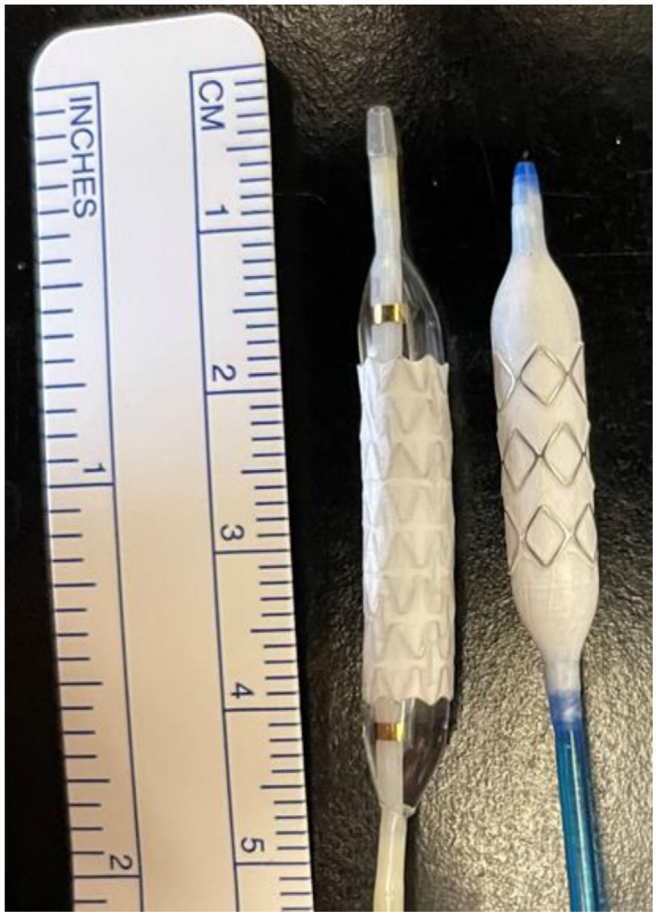

Fig 4. Comparison of Atrium iCAST **(left)** and Gore VBX **(right)** balloon-expandable covered stents after inflation with saline aligned at the distal balloon attachment point.

inflates symmetrically along the catheter. Therefore, the longer nose cone and asymmetric balloon inflation were advantageous to deploying the stent in the branching distal RHA. The specifics of this case study cannot be generalized to other patients or stent delivery systems. However, such subtle design differences are important considerations when treating complex lesions within the tortuous and branching hepatic vasculature and may influence the success of an endovascular intervention.

CONCLUSIONS

We report the endovascular stent repair of a large right HAA using balloon-expandable covered stents. The LHA was covered to obtain proximal seal without adverse clinical outcomes. Our surgical decision-making was informed by multimodal imaging data, the patient's unique vascular anatomy, and the design features of our stent delivery systems. This report highlights the importance of a patient-specific approach to managing HAAs and the promise of novel stent technology in such complex interventions.

DISCLOSURES

None.

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Submitted Jun 13, 2024; accepted Aug 2, 2024.