Vascular coil extrusion into the duodenum 6 years after hepatic artery aneurysm embolization

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ABSTRACT

A 50-year-old man with a history of coil embolization of a symptomatic 5.3-cm hepatic artery aneurysm 6 years previously presented with a massive gastrointestinal bleed. He was found to have embolization coils extruding into the duodenum from a hepaticoduodenal arterioenteric fistula. The present case demonstrates that endovascular intervention for a large hepatic artery aneurysm can have long-term consequences. We have described a novel complication of embolization of a giant hepatic artery aneurysm that necessitated complex open repair. (J Vasc Surg Cases Innov Tech 2021;7:772-7.)

Keywords: Embolization; Hepatic aneurysm

Hepatic artery aneurysm is a rare pathology. The exact incidence of hepatic artery aneurysm remains unknown. However, with the increasing use of cross-sectional imaging, their diagnosis has become more frequent. A retrospective study from the Mayo Clinic between 1980 and 1998 identified 36 patients with a hepatic artery aneurysm.[1] This study estimated the incidence at ~0.002%.[1] Although uncommon, hepatic artery aneurysms are the second most common type of visceral aneurysm after splenic artery aneurysms and represent 20% of all visceral aneurysms.[2,3] Hepatic artery aneurysms have the highest rate of rupture of visceral artery aneurysms with high mortality (≤40%) if left untreated.[1,4] The indications for repair include size >2 cm, progressive growth (>0.5 cm/y), and the presence of symptoms (eg, pain, obstructive jaundice, gastrointestinal bleeding, hemobilia, rupture). Giant hepatic artery aneurysms (size >5 cm) are rare. True aneurysms most commonly develop in the extrahepatic artery and usually involve the common hepatic artery. The treatment options include open surgery, transcatheter arterial embolization, stent-graft placement, and direct percutaneous injection of thrombin or glue. When anatomically feasible, endovascular repair of hepatic artery aneurysms is preferred over an open approach owing to the benefits of lower procedural morbidity and mortality.[5-8]

In the present report, we have described complex open repair of a hepaticoduodenal` fistula in a patient who had undergone embolization of a giant hepatic artery aneurysm. The patient provided written formal consent for the report of his case details and imaging studies.

CASE REPORT`

A 50-year-old Hispanic male patient had presented with massive gastrointestinal bleeding. He had undergone coil embolization of a large common hepatic artery aneurysm 6 years previously. At that time, he had presented with a 3-week history of progressively worsening back and abdominal pain. The pertinent laboratory test results included a normal white blood cell count, liver enzymes, and erythrocyte sedimentation rate. The blood culture results were negative. He had a history of hypertension and coronary artery disease with left anterior descending stent placement via left radial artery access 1 year earlier. He had no history of abdominal trauma or surgery and no history of tobacco or alcohol abuse. The screening results for vasculitis, autoimmune disease, and connective tissue disorders were normal (negative for antinuclear antibodies, rheumatoid factor, and *FBN1*, *TGFBR*, and *COL* genes). Computed tomography angiography (CTA) revealed a 5.3-cm × 5.1-cm common hepatic artery aneurysm. The morphology of the aneurysm involved the entire common hepatic artery with a broad-based neck (Fig 1). Transfemoral catheter angiography indicated a replaced right hepatic artery originating from the superior mesenteric artery and a replaced left hepatic artery originating from the left gastric artery (Fig 2). He underwent coil embolization of the common hepatic artery aneurysm with five coils (32-mm × 60-cm Ruby coil and 28-mm × 60-cm Ruby coil [Penumbra, Alameda, Calif]; 22-mm × 30-cm × 3 interlock coils [Boston Scientific, Marlborough, Mass]) combined with instillation of 2500 U of thrombin into the sac. The coils were placed proximal to the origin of the gastroduodenal artery. The neck of the aneurysm was excluded by placement of a 5-mm × 22-mm iCAST stent-graft (Atrium Medical Corp, Merrimack, NH) into the left gastric artery, with the proximal aspect of the stent docked into the celiac trunk. This allowed for preservation of flow into the replaced left hepatic artery. Continued filling of the replaced right hepatic artery through the superior mesenteric artery was visualized. He was prescribed clopidogrel for 1 month and

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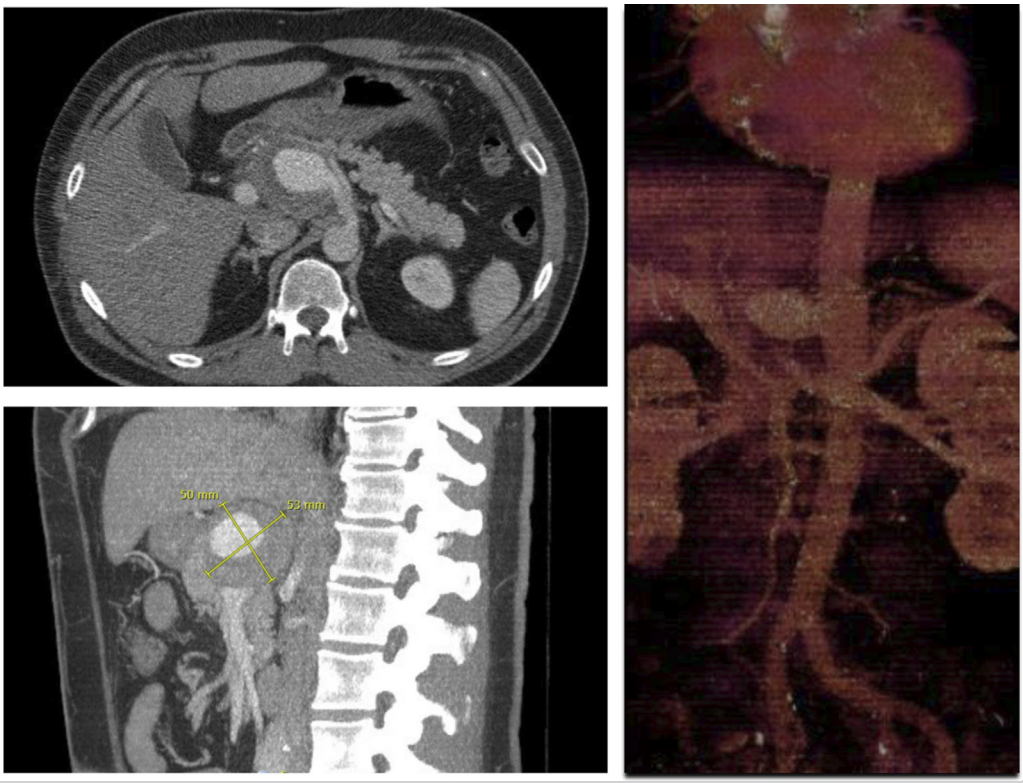

Fig 1. Computed tomography angiography (CTA) of a 5.0-mm × 5.3-mm common hepatic artery aneurysm.

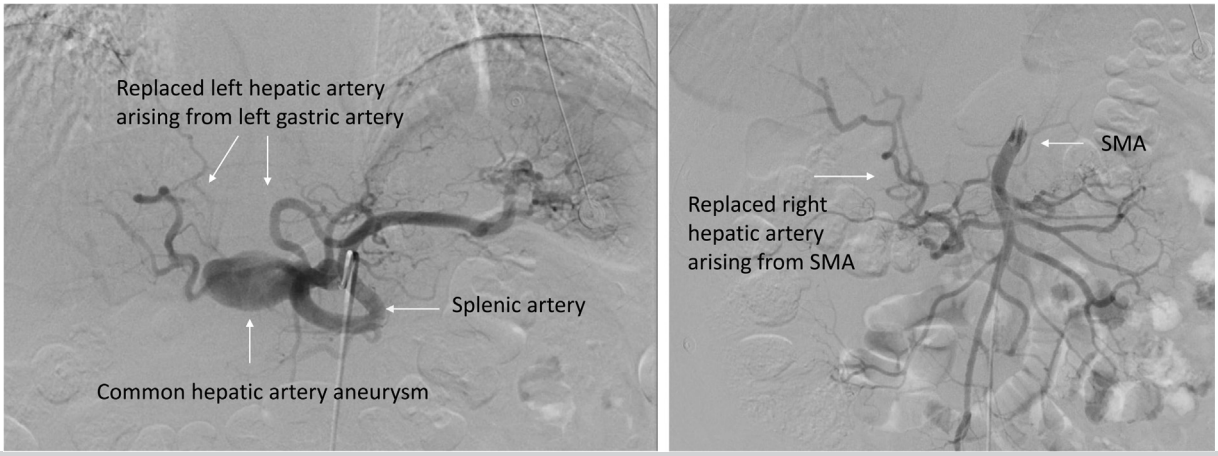

Fig 2. Contrast-enhanced angiogram demonstrating the common hepatic artery aneurysm and replaced left hepatic artery originating from the left gastric artery and replaced right hepatic artery originating from the superior mesenteric artery.

aspirin indefinitely. However, 6 months after this procedure, he had presented with recurrent back pain. CTA revealed contrast filling of the aneurysm sac. Three additional coils (Concerto coils, 14 mm × 30 mm; Medtronic) were placed into the aneurysm sac. Continued forward filling of the aneurysm sac was present owing to incomplete exclusion of the neck by the previous iCAST stent-graft. An 8-mm Amplatzer plug (AVP 4; Abbott Laboratories) was deployed alongside the stent-graft to obliterate the gutter flow and eliminate contrast filling of the aneurysm sac. The stent-graft remained patent, with continued filling of the replaced left hepatic artery (Fig 3).

During the next 6 years, he had undergone annual CTA and duplex ultrasound surveillance imaging, which demonstrated no contrast filling of the sac nor diameter changes, albeit the findings were limited by metallic artifact, bowel gas, and body habitus. He remained asymptomatic during this time. When the patient had presented with massive gastrointestinal bleeding 6 years later, endoscopy revealed a large duodenal

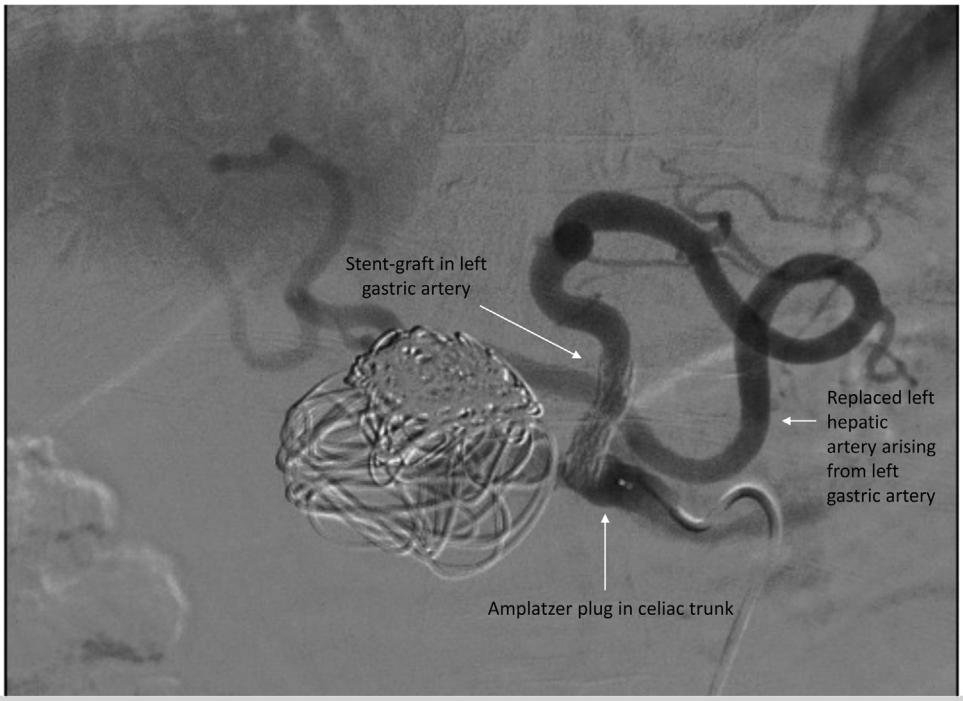

Fig 3. Coil embolization of the common hepatic artery aneurysm and exclusion of the neck of the aneurysm by an iCAST stent-graft (docked from the proximal celiac artery into the left gastric artery; Atrium Medical Corp). An Amplatzer plug (Abbott Laboratories) was placed alongside the iCAST stent-graft.

ulcer with visualization of a portion of a coil protruding into the duodenal lumen (Fig 4). This coil extrusion into the duodenum was visualized on CTA (Fig 4), which had not been seen on the surveillance CTA 8 months prior. The portal venous system was patent on duplex ultrasound imaging. The patient was taken to the operating room. A standard chevron incision was performed. Supraceliac control of the aorta was obtained. The lesser sac was entered to control the proximal celiac artery. The proper hepatic artery distal to the aneurysm sac was controlled in the porta hepatis. Intraoperative duplex ultrasound was used to confirm continued flow in the hepatic artery with test clamping of the proper hepatic artery and proximal celiac artery. The first portion of the duodenum was noted to be adherent to the aneurysm sac. Proximal duodenotomy was performed, and a cluster of coils was directly visualized eroding from the aneurysm sac into the duodenum (Fig 5). The aneurysm sac was completely thrombosed. The coils and Amplatzer plug were extracted. The celiac artery trunk was ligated proximal to the left gastric artery. The left gastric artery was ligated after removal of the stent-graft. The sac was excised, and the outflow hepatic artery was suture ligated from within the aneurysm sac. No color changes were noted in the liver parenchyma. Intraoperative ultrasound confirmed pulsatile waveforms in both hepatic arteries; therefore, no revascularization was undertaken. The duodenum stump was managed with a drain, and gastrojejunostomy was performed. The total operative time was 9 hours, 29 minutes. The patient underwent transfusion with 1 U of packed blood cells. Histopathologic examination of the aneurysm sac indicated no vasculitis, fibromuscular dysplasia, nor cystic medial necrosis. Bacteria were not detected on the removed coils, stent-graft, plug, or aneurysm sac. Liver function remained normal postoperatively. His postoperative course was complicated by delayed gastric emptying, and he was discharged to home on postoperative day 26. Postoperative CTA indicated normal hepatic parenchymal enhancement.

DISCUSSION

Most patients with a hepatic artery aneurysm will be asymptomatic until rupture. The clinical diagnosis of a hepatic artery aneurysm can be suggested by the classic symptoms of right upper quadrant pain, hemobilia, and obstructive jaundice (Quincke's triad). CTA is most commonly used to diagnose hepatic artery aneurysms and allows for a panoramic and precise characterization of the aneurysm. A hepatic artery pseudoaneurysm can occur from blunt abdominal trauma, a local inflammatory process, infection, or iatrogenically from biliary interventions. True hepatic artery aneurysms are related to atherosclerosis, hypertension, hyperflow conditions (eg, pregnancy, portal hypertension), vasculitis (eg, polyarteritis nodosa, Takayasu's arteritis), autoimmune disease (eg, systemic lupus erythematosus), connective tissue disorders (eg, Marfan syndrome, Ehlers-Danlos syndrome, fibromuscular dysplasia), and infection. The recently published Society for Vascular Surgeons guidelines have recommended intervention for all patients with hepatic artery pseudoaneurysms, all symptomatic patients with hepatic artery aneurysms regardless of size,

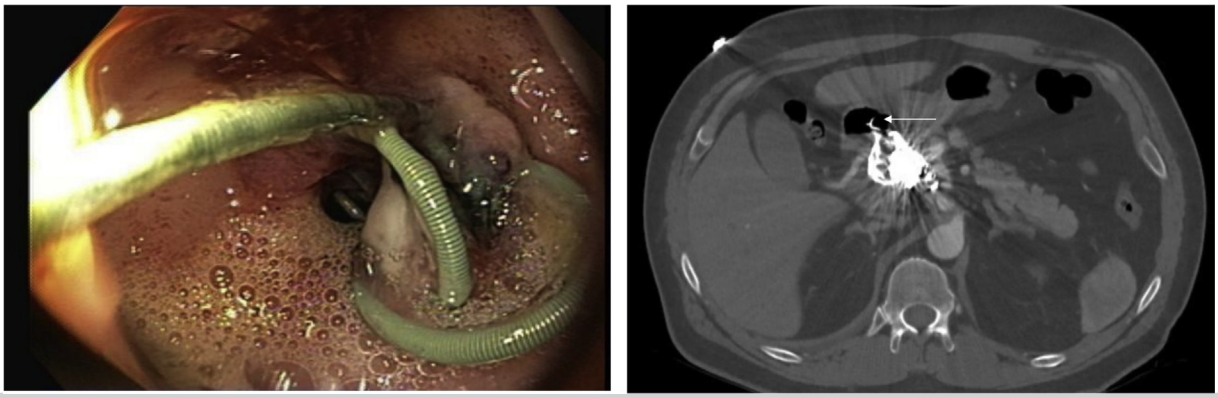

Fig 4. Coil protruding into the duodenum visualized on endoscopic examination and computed tomography angiography (CTA; *arrow*).

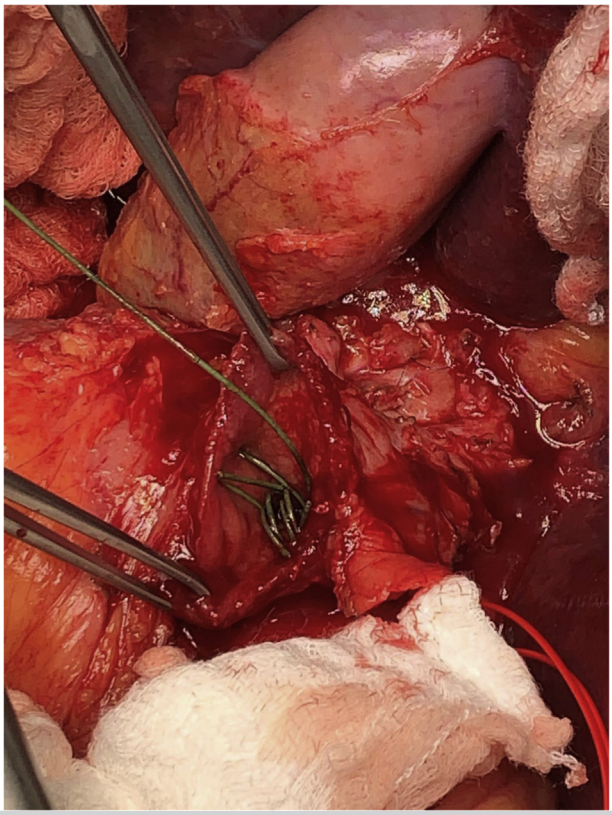

Fig 5. Coil extrusion after duodenotomy was performed.

asymptomatic patients without significant comorbidities with true hepatic artery aneurysms >2 cm, patients with aneurysm enlargement of ≥0.5 cm/y, and patients with significant comorbidities and an aneurysm >5 cm.[8]

Open surgical repair has been the traditional method of treatment.[3] Surgery can be performed open, laparoscopically, or robotically. Surgery relies on different strategies, including ligation and exclusion of the aneurysm with or without vascular reconstruction and hepatic resection. Endovascular treatment uses coils, vascular plugs, injection of liquid embolic agents or thrombin, stent-grafting, or multilayer stenting. Endovascular treatment is now considered the first-line treatment and might result in better outcomes because it is less invasive. Although no prospective randomized controlled trials have compared open and endovascular repair for the treatment of visceral aneurysms, several studies have validated the preferential use of endovascular therapy.[6,7] The Society for Vascular Surgery guidelines have recommended an endovascular-first approach for all hepatic artery aneurysms if anatomically feasible.[8] Size was not included as a consideration in these guidelines. For our patient, we used a multitude of endovascular strategies to treat a giant hepatic artery aneurysm, including detachable bare metal and fibered coils within the aneurysm sac, thrombin injection within the sac, and stent-graft and Amplatzer plug placement to occlude the neck of the aneurysm. All these modalities have been used in the successful endovascular treatment of hepatic artery aneurysms.[5-8]

The status of the gastroduodenal artery is pivotal to the treatment algorithm for both operative and endovascular repair.[9] An anastomotic arcade exists between the celiac and superior mesenteric arteries via the gastroduodenal artery and right gastric arteries. Ligation or transarterial embolization of the hepatic artery distal to the gastroduodenal artery can result in hepatic ischemia if the collateral branches are insufficient. It has been generally accepted that aneurysms of the common hepatic artery that do not involve the gastroduodenal artery can be simply ligated without reconstruction because the proper hepatic artery will be supplied by the reverse flow from the gastroduodenal artery. For aneurysms involving the gastroduodenal artery or distal to its origin, most investigators have advocated vascular reconstruction to avoid the risk of ischemic injury to the liver. However, the liver has dual vascularization, with the portal vein providing 70% of

the liver blood flow and hepatic artery providing 30%. Recent studies have shown that even arterial ligation distal to the gastroduodenal artery origin does not necessarily result in ischemic liver injury, perhaps protected by the buffer response of the portal venous system.[10,11] Initial surgical treatment in the present case with ligation of the celiac artery proximal to the left gastric artery and ligation of the common hepatic artery without revascularization would have avoided the need for surveillance and its attendant radiation exposure and the ensuing complications of dense physical coil packing and duodenal erosion. Although the appropriate surveillance protocol after endovascular treatment of visceral artery aneurysms has not yet been established, the Society for Vascular Surgery clinical practice guidelines have recommended surveillance axial imaging studies every 1 to 2 years after embolization to assess for aneurysm reperfusion.[8]

The most common mode of endovascular treatment of hepatic aneurysms is coil embolization. The site, morphology, and status of the collateral circulation will determine the feasibility of embolization. The ideal placement of coils has been a point of contention. Some have advocated packing of the aneurysm itself; this is especially appealing for saccular aneurysms with narrow necks.[12] In the isolation technique, the efferent and afferent arteries will be coil embolized. If branch vessels arise from the aneurysm sac, this technique will not be effective because of possible feeding by retrograde flow. In the sandwich technique, the efferent artery, aneurysm sac, and afferent artery will typically be packed with coils during progressive retraction of a catheter. Because the front and back entries will be occluded, the aneurysm can be packed less densely. The packing density determined by the volume of the inserted coils divided by the aneurysm volume and has been used as an estimate of the extent to which an aneurysm should be filled with embolic coiling material. An inferior packing density has been shown to be an important predictor for recanalization of visceral aneurysms. Yasumoto et al[13] reported no recanalization for a mean of 37 months in 46 aneurysms with a packing density of ≥24%. Aneurysm coil migration into the gastrointestinal tract after angioembolization of visceral artery aneurysms has been described but has been exceedingly rare.[14–17] Although the exact mechanism of migration is unknown, factors that can contribute include instability of the aneurysm wall, the proximity of coils to adjacent hollow structures, underlying inflammation, and aneurysm sac overpacking. Some studies have reported that the risk of coil migration can be minimized by sandwich embolization without excessive filling of the aneurysm space. In the present case, we used both bare platinum coils (Ruby; Penumbra) and fibered coils (Concerto [Medtronic] and Interlock [Boston Scientific]) to achieve an eventual packing density of ~20%. It might be prudent to limit the volume of coils used during embolization to the minimum necessary to achieve thrombosis, especially in the case of a giant hepatic artery aneurysm. Isolation embolization or stent grafting across the aneurysm could not be used in our patient because of the need for gastroduodenal artery sacrifice to secure a distal landing zone.

CONCLUSIONS

We have presented a remote complication of embolotherapy of a giant hepatic aneurysm. The findings from the present case serves as a cautionary tale that embolization of hepatic artery aneurysms can lead to erosion into the intestinal tract. Open repair should be considered for young patients without significant comorbidities, especially when the size >5 cm. Classic surgical treatment would circumvent the need for surveillance and the risk of aneurysm recanalization and stent thrombosis. The treatment strategies have been highly varied and should be individualized for each patient according to the anatomic location, collateral flow, hemodynamic status, life expectancy, and comorbidities.

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