Radiology Case Reports 18 (2023) 4537–4543

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journal homepage: www.elsevier.com/locate/radcr

Case Report

Recurrent hepatic artery pseudoaneurysm repair with overlapping tapered stent-graft technique ☆

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ARTICLE INFO

Article history:
Received 2 August 2023
Revised 12 September 2023
Accepted 14 September 2023

Keywords:
Covered stent
Hepatic artery infusion pump
Hepatic artery pseudoaneurysm
Multiple overlapping tapered stents
Pseudoaneurysm stenting
Stent-graft

ABSTRACT

Hepatic artery pseudoaneurysms (HAPs) are rare but life-threatening complications associated with hepatic artery infusion pump (HAIP) therapy for unresectable liver metastases. Traditional management options include open surgery or stent placement, but these approaches have drawbacks. We present a unique case of a dislodged stent embedded in a HAP, resulting in delayed type-I endoleak. To address this, we employed a novel technique using multiple overlapping tapered stents to reconstruct the hepatic artery. This approach successfully excluded the pseudoaneurysm without endoleak. Stent-graft placement emerges as a safer and more effective option for managing HAP, preserving hepatic arterial flow, and reducing morbidity compared to other methods. However, further research is needed to evaluate this technique's long-term outcomes and potential complications.

Introduction

The hepatic artery infusion pump (HAIP) device has been employed as a viable therapy for unresectable liver metastases in particular patients, especially in patients with hepatic metastatic disease from colorectal cancer. The first reference to this intervention can be traced back to the 1960s, documented across several case studies [1]. The HAIP is placed surgically via the gastroduodenal artery (GDA) to access hepatic circulation. This modality provides high-dose chemotherapy directly into the liver while minimizing systemic side effects. However, HAIP is not without its pump-related; catheter-related; vascular; or biliary complications [2–4]. One rare but serious complication is the development of a hepatic artery pseudoaneurysm (HAP). HAP is a rare but potentially life-threatening complication of HAIP, with a reported incidence of less than 5% [5], a high risk of rupture, and consequent massive hemorrhage associated with a mortality rate of up to 60% [2]. Due to the high mortality rate, early diagnosis and management of HAP is crucial.

Traditional management options of HAP included open surgical vessel repair and vessel ligation [6]. Endovascular therapies like embolization or stent-graft placement have recently been used to manage HAP, given its less invasive nature [6,7]. Despite being a commonly used treatment modality, stenting has a few inherent drawbacks. Among the most prevalent are instances of stent failure, often attributed to

☆ Competing Interests: The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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https://doi.org/10.1016/j.radcr.2023.09.038

Fig. 1 – Coronal abdominal CTA demonstrating the extra arterial position of the HAIP catheter tip (black arrow) located inferior to the GDA stump (white arrow).

complications such as thrombosis or leakage [8]. Studies indicate that short-term patency rates remain significantly low when deployed to manage pseudoaneurysm specifically [9].

The following case report outlines a unique complication wherein the stent becomes dislodged and embedded into the wall of the pseudoaneurysm in an extreme form of delayed type-I endoleak. To our knowledge, this occurrence has yet to be documented before. To address this uncommon incident, it was necessary to develop a tapered overlapping stent placement to reconstruct the hepatic artery. This presentation aims to shed light on the complexities and potential complications associated with HAIP.

Case presentation

A 57-year-old male with a history of sigmoid colon cancer, status postresection in 2016 with subsequent metachronous liver metastatic lesions, which rendered the patient a nonsurgical candidate. He underwent a period of chemotherapy, to which he responded. The patient was then referred to surgical oncology for consideration of hepatic artery infusion pump placement. The patient had conventional hepatic arterial anatomy and had a large exophytic tumor in segment 4/5 extending toward the hepatic pedicle, with a second large central tumor involving all 3 hepatic veins and extending to the caudate lobe and numerous other smaller lesions. However, there was no evidence of extrahepatic disease. The patient had a good functional status and normal liver function tests, so subsequently, he underwent hepatic artery infusion pump placement (Intera 3000) in September 2022 without evidence of immediate complications. He started receiving periodic Floxuridine (FUDR) via HAIP infusion concomitantly with systemic chemotherapy.

In December 2022, the patient presented to the emergency department with worsening abdominal pain over the preceding 5 days and underwent a computed tomography (CT) scan of the abdomen, which was concerning for small bowel obstruction. Incidentally, the hepatic artery infusion pump catheter tip was found to be dislodged. Initially placed HAIP catheter tip at the takeoff of the GDA from the common hepatic artery, with Floxuridine (FUDR) extravasation eroding further into the inferior aspect of the common hepatic artery. In addition, a 5 × 3 mm inferiorly oriented focal outpouching in the common hepatic artery was noted, which was suspicious for a small pseudoaneurysm/prominent GDA stump (Fig. 1). The patient underwent SPECT/CT with injection of Tc-99m macroaggregated albumin (MAA) via the HAIP subcutaneous port, this showed extravasation of radiotracer from the distal tip of the HAIP adjacent to its initial insertion site into GDA stump, with associated free extravasation into multiple locations within the abdomen.

After a multidisciplinary discussion, the decision was made to proceed with the removal of the hepatic artery infusion pump. Initially, an esophago-gastro-duodenoscopy (EGD) was performed to evaluate for the erosion of the catheter into the duodenum with the resultant exclusion of duodenal involvement. The HAIP was removed surgically from the subcutaneous pocket, while the catheter proximal end was sutured to the posterior aspect of the left rectus fascia. The tubing was not pulled out, as it is common management to leave HAIP tubing in place. Interventional radiology was then consulted for common hepatic artery repair in the setting of GDA stump pseudoaneurysm. The patient underwent a diagnostic angiogram by interventional radiology, which confirmed the findings on CTA (Fig. 2). Subsequently, a 6 mm ×

Fig. 2 – Digital subtraction angiogram of the celiac artery demonstrates a small outpouching arising from the common hepatic artery, consistent with the known GDA stump noted on CTA (white arrow). The hepatic artery infusion pump catheter tip is displaced inferiorly (black arrow).

Fig. 3 – Poststenting digital subtraction angiogram of the celiac artery demonstrates successful stent placement across the common hepatic artery GDA stump (black arrows) with complete coverage of the wall defect.

2.5 cm VIABAHN stent (W. L. Gore & Associates, USA) was selected for coverage across the wall defect. It was also successfully deployed with complete coverage/resolution of the GDA stump/pseudoaneurysm (Fig. 3).

Follow-up imaging at 4 months showed an increase in the size of the common hepatic artery pseudoaneurysm, measuring 3.6 × 1.4 cm (Fig. 4). Interestingly, the previously deployed common hepatic artery stent was completely extraluminal in relation to the common hepatic artery as it became totally engulfed by the enlarging aneurysmal sac. Interventional radiology was re-consulted for evaluation and management. The patient underwent a diagnostic angiogram; the initial digital subtraction angiogram of the celiac artery demonstrated a large hepatic artery pseudoaneurysm with extrusion and complete engulfment of the stent within the aneurysmal sac and severe narrowing of the common and proper hepatic arteries (Fig. 5). Subsequently, the narrowing was crossed, and over the wire, a 7 × 39 mm, a 6 × 39 mm, and a 5 × 29 mm Viabahn VBX stents (W. L. Gore & Associates, USA) were overlapped and deployed with complete exclusion of the pseudoaneurysm, without evidence of endoleak after postdeployment digital subtraction angiography (Fig. 6). The stents were de-

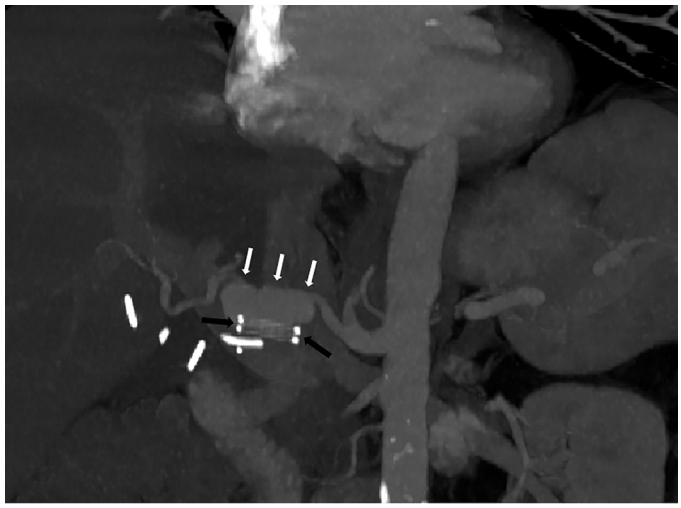

Fig. 4 – Coronal CTA of the abdomen showing complete engulfment of the previously placed hepatic artery stent with the enlarged pseudoaneurysmal sac (black arrow) measuring approximately 3.6 x 1.4 cm (white arrows).

Fig. 5 – Digital subtraction angiogram of the celiac artery demonstrated extrusion of the previously placed hepatic artery stent (black arrow) within the pseudoaneurysmal sac (white arrow).

ployed in a pressure-controlled fashion with at least 5 mm of overlap between each adjacent stent while using a combination of stent under-dilation and over-dilation of the VBX stents (W. L. Gore & Associates, USA) to achieve a complete seal at the overlapping ends.

The patient underwent a follow-up abdominal CT angiography which confirmed no residual filling of the pseudoaneurysm and excluded the presence of an endoleak (Figs. 7 and 8). Finally, the patient was discharged on dual antiplatelet therapy and recommended to follow up with interventional radiology 3 months poststenting.

Discussion

The use of HAIP in managing colorectal cancer liver metastases has improved overall survival with reported improved response rates [4]. However, the use of this management modality has associated complications. One of the common catheter-related complications is pseudoaneurysm formation, which can be seen in less than 5% of patients with HAIP [5].

Hepatic artery pseudoaneurysmal formation is often related to the erosion of the catheter through the GDA. In 5%-18% of the patients, catheter tip migration or displacement occurs distally from GDA or proximally from the pump [4,10]. The distal dislodgement from GDA is usually a chronic process, presenting without symptoms or mild abdominal discomfort, as slow leakage of chemotherapeutic drugs leads to thrombus formation and, ultimately, fibrosis [5]. As patients are asymptomatic, the catheter might freely leak into the peritoneal cavity, and both catheter migration and/or pseudoaneurysm are incidentally detected on imaging (Fig. 1). Rarely, it may present with rupture of pseudoaneurysm with

Fig. 6 – Poststenting digital subtraction angiogram of the celiac artery demonstrates successful stent placement extending from the common hepatic artery to the proper hepatic artery with complete coverage of the wall defect (black arrows) and exclusion of the previous common hepatic artery stent (white arrows).

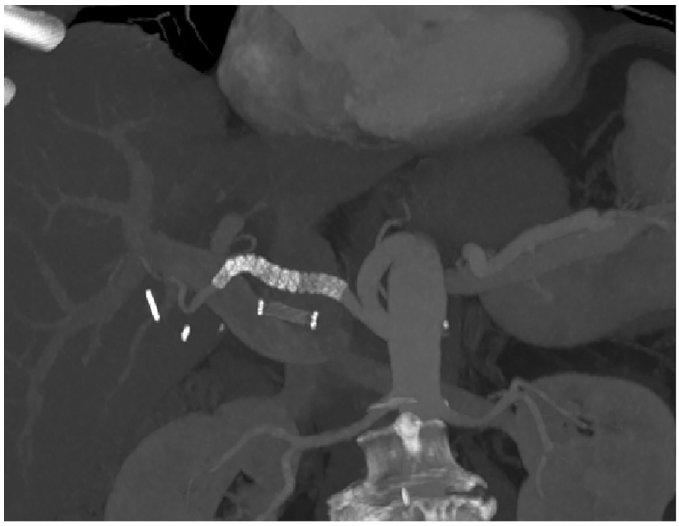

Fig. 7 – Reconstructed coronal CTA of the abdomen demonstrates patent stent extending from the common hepatic artery to the proper hepatic artery (black arrows), complete resolution of the pseudoaneurysm, and exclusion of the previous common hepatic artery stent (white arrows).

acute abdominal pain and hypotension leading to shock [11–13].

In our case, the HAIP complication was initially identified as a displaced catheter tip without any apparent fluid collection around the tip with GDA stump enlargement and extravasation. After placement of the initial stent-graft, the patient reported improvement in symptoms; however, continued FUDR damaging effect on the common hepatic arterial wall led to the development of a type-I endoleak near one of both ends of the stent-artery interface, leading to pseudoaneurysmal sac enlargement followed by complete engulfment of the stent within the aneurysmal sac. This complication highlights the need for early detection of pseudoaneurysm recurrence post-HAP stenting. A follow-up CT of the abdomen should be conducted. However, there are no clear recommendations on the correct time frame. This is particularly important given the high morbidity and mortality associated with undetected cases [14]. Therefore, it is recommended to maintain a high index of suspicion when assessing clinical and imaging findings in this group of patients.

The most straightforward approach in this secondary complication would have been to perform an embolization of the common hepatic artery [6]. However, in patients with an already reduced hepatic reserve, given the background of high-burden liver metastases and numerous cycles of systemic chemotherapy, the risk of liver failure, biliary injury, and liver abscesses cannot be understated.

The placement of a hepatic stent-graft to reconstruct hepatic arterial anatomy can be a safe and effective option to avoid these complications. The choice of multiple overlapping

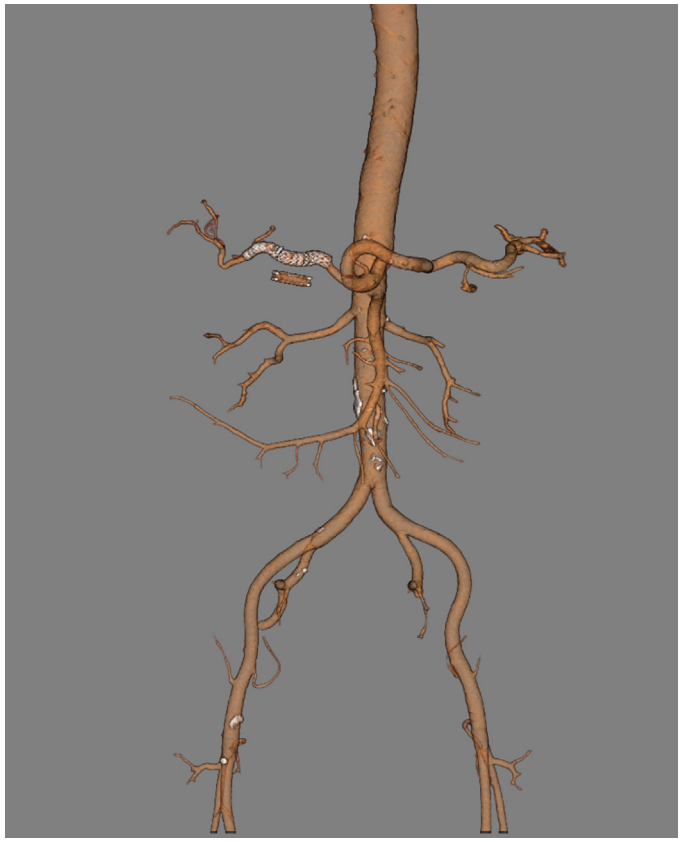

Fig. 8 – Volume rendered CTA of the abdominal aorta demonstrating complete exclusion of the hepatic artery pseudoaneurysm.

tapered endovascular stent-graft has shown good results in coronary and carotid arteries [15,16]. In our case, we used 3 Viabahn VBX-covered stents (W. L. Gore & Associates, USA) to exclude the giant secondary pseudoaneurysm with effective resolution of the type-I endoleak. The stent overlap technique using 3 different stent-graft sizes was used to reconstruct the common and proper hepatic arteries in an anatomically appropriate fashion with tapering from proximal to distal vasculature without excessive oversizing of the vessel. Stent overlapping has been described in other vascular territories, such as the carotids and the coronaries [16,17]. Stent-graft placement as a management option for hepatic pseudoaneurysms has shown better outcomes than other techniques [11,18]. Stent-graft placement has been shown to control hemorrhage in emergency settings while preserving hepatic arterial flow, with far less morbidity and mortality than other techniques [8,19,20].

However, stent-graft placement has its own complications. Although there is generally a reported high technical success in all the published reports, the placement of multiple overlapping stents in a tapering fashion has not been reported [21,22]. This approach may not be practical in acute hemorrhaging unstable patients. The procedure itself may lead to massive hemorrhage due to the fragility of the vessel wall and the need for stent over-dilation to achieve a complete seal of overlapping ends. Stent-graft placement itself carries the inherent risk of stent occlusion and vessel thrombosis [7].

Conclusion

The use of stent-grafts to treat life-threatening or nonbleeding hepatic artery pseudoaneurysms is a safe and effective option to manage this potentially deadly complication while preserving hepatic arterial perfusion. It is preferable to both hepatic artery embolization and surgical repair. When feasible, this approach should be prioritized as the primary treatment for HAP, especially in cases where liver function is already compromised. However, additional data are required to assess the effectiveness, potential complications, and long-term results of using multiple overlapping stent-grafts to reconstruct the hepatic artery in the setting of a giant pseudoaneurysm.

Instrument name

Gore Viabahn VBX balloon-expandable endoprosthesis, “W. L. Gore & Associates, USA’’.

Patient consent

Informed consent was obtained after we ensured that patient understood the implication of publication.

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