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Case report

Splenic artery transposition for reconstruction of a large hepatic artery aneurysm: A case report and literature review

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ABSTRACT

Introduction and importance: Hepatic artery aneurysms (HAAs) are rare. Typical treatment options for HAAs are surgical resection and endovascular treatment but treatment choices remain controversial.

Case presentation: A 65-year-old woman was rushed to our hospital suspected to have hemorrhage. Contrast-enhanced CT showed a large 12 cm aneurysm of the common hepatic artery (CHA). We diagnosed duodenal hemorrhage due to imminent rupture of the HAA. Angiography was first performed. The inferior pancreaticoduodenal artery was embolized with a coil under interventional radiology technique for arterial bleeding control. Next, we performed resection of the aneurysm and total pancreatectomy with splenic artery reservation. We reconstructed via splenic artery transposition because of the reconstruction distance, vascular system, and stability of the anastomosis. The patient was discharged from the hospital on postoperative day 21 without any complications.

Clinical discussion: There are two key points in this report. Firstly, the choice of splenic artery transposition is optimal for caliber difference and reconstruction distance. The choice of splenic artery should be considered a reliable option. Secondly, total pancreatectomy avoids exposure to pancreatic juice at the anastomosis site due to pancreatic fistula.

Conclusion: Splenic artery transposition for HAA is advantageous in adjustability of the caliber difference and securing of sufficient distance. In addition, total pancreatectomy may be acceptable in patients with a normal pancreas to avoid fatal complications such as disruption of the anastomosis and reconstructed artery due to pancreatic juice exposure.

1. Introduction

Visceral artery aneurysms (VAAs) are rare (0.01% to 0.2% of all aneurysms [1]) and often involve the hepatic and splenic arteries. Hepatic artery aneurysms (HAA) are the second-most common after splenic artery aneurysms (SAA) and are often detected asymptomatically and incidentally. Rupture is the first symptom in 64–80% of cases [2–4]), carrying a mortality rate of 70% or more [5]. Indications for VAA treatment is symptomatic, pseudoaneurysm, size (>2 cm), rapidly growing mass, vasculitis, and woman of childbearing age [3,4,6]. Typical treatment options for hepatic aneurysms are surgical resection and endovascular treatment but treatment choices remain controversial since hepatic artery blood flow should be maintained during treatment and strategies vary by individual case. Here, we report a case of ruptured hepatic aneurysm treated by total pancreatectomy and arterial reconstruction using splenic artery transposition. Additionally, we discuss the optimal treatment choice based on literature review. This work has been reported in line with the SCARE criteria [7].

2. Presentation of case

A 65-year-old woman visited a local clinic complaining of hematemesis. A simple computed tomography (CT) scan showed a mass in the anterior surface of the pancreatic head and a hematoma in the stomach. She was transferred to our hospital in shock with a diagnosis of gastrointestinal bleeding due to a tumor. Previous medical history was

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otherwise unremarkable.

Body temperature was 36.1 °C, blood pressure was 87/58 mmHg, pulse rate was 74 bpm, height was 150.0 cm, weight was 54.8 kg, BMI was 24.36, ECOG Performance Status was 0, and she had abdominal distension. Laboratory investigation showed a leukocyte count of 22,700/μL, hemoglobin of 9.3 g/dL, platelet count of 214,000/μL, and D-dimer of 4.5 μg/mL. Other biochemical parameters (urea, creatinine, electrolytes, transaminases, bilirubin, prothrombin time, INR) were within normal limits.

Contrast-enhanced CT showed a large 12 cm aneurysm of the common hepatic artery (CHA) branching from the CHA root to the bifurcation of the right and left hepatic arteries on the cephalic side and to the right gastroepiploic artery and inferior pancreatic duodenal artery on the caudal side (Fig. 1a,b,c). We diagnosed duodenal hemorrhage due to imminent rupture of the common hepatic artery aneurysm and decided to perform pancreaticoduodenectomy with aneurysm resection and hepatic artery reconstruction. She was taken out of shock by rapid infusion.

After abdominal pain and hematemesis, the patient was transferred to the emergency room within 2 h, and under general anesthesia within 2 h after that, emergency angiography and emergency surgery were performed at the same time. Angiography was first performed to evaluate the vascularization (Fig. 1d). The aneurysm originated in the common hepatic artery and extended to the proper hepatic artery, gastroduodenal artery, right gastroepiploic artery, and inferior pancreaticoduodenal artery (Fig. 2). At this point, the inferior pancreaticoduodenal artery was embolized with a coil under interventional radiology (IVR) technique for arterial bleeding control. Since there was no other hepatic blood supply other than from aneurysmal branches, arterial reconstruction was deemed necessary. Next, we attempted radical resection of the aneurysm; however, dissection was difficult because of a poorly defined border between the aneurysm and normal pancreatic tissue. Thus, the aneurysm was dissected from the anterior surface of the portal vein and the duodenum was mobilized. As end-to-end anastomosis of the hepatic artery was difficult because of the distance, we decided to reconstruct via splenic artery transposition because of the reconstruction distance, vascular system, and stability of the anastomosis. In addition to pancreaticoduodenectomy, we performed a total pancreatectomy with preservation of the splenic artery to the periphery (Figs. 3, 4). In order to reduce complication risks in the reconstructed artery, we designed the HAA line of dissection so that the end-to-end anastomosis of the vessel would be in one place. A total of 12 cm of splenic artery was inverted to the right side and anastomosed end-to-end with the intrinsic hepatic artery using 5–0 PROLENE (Fig. 5). The specimen showed that there was no obvious perforation of the aneurysm into the duodenum.

The patient was discharged from the hospital on postoperative day 21 without any complications and with relatively facile blood sugar control.

3. Discussion

In this case, as endovascular treatment was contraindicated due to the large size of the aneurysm, surgical treatment with revascularization was the only option. The choice of reconstruction method is a key point but since hepatic aneurysms are rare, reconstruction methods are not yet standardized.

The key points of the surgical planning in this report are the selection of the splenic artery as the reconstructive artery for hepatic artery reconstruction and that total pancreatectomy was selected due to expected postoperative pancreatic fistula.

Firstly, the choice of splenic artery has been well reported. Of the 5 advantages of splenic artery transposition listed by Alim et al. [8] and Tanaka et al. [9]) easy access, autologous artery, adjustable caliber difference (even for the hepatic artery that was resected with a part of the aneurysm wall remaining), and sufficient distance were crucial in our case. Of these, we believe that the most important advantages of the splenic artery are the adjustable caliber difference and ability to secure sufficient distance. A PubMed search using the keywords “open surgery” and “hepatic artery aneurysm” revealed 15 cases of hepatic artery resection and reconstruction among 10 years from 2011 to 2021, including our own cases (Table 1) [10–22]. Five cases had autologous arterial reconstruction and four of these five cases had splenic artery transposition. Three had great saphenous vein (GSV) or femoral vein (FV) grafts, two had bypass with artificial vessels, and six did not undergo revascularization. One patient with vein graft had postoperative

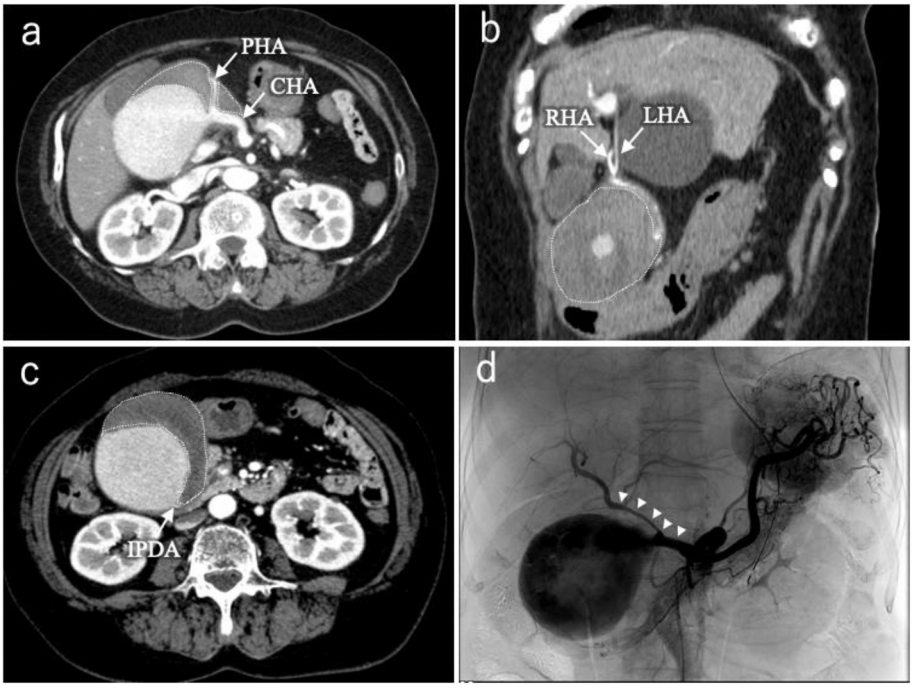

Fig. 1. A large 12 cm aneurysm branch from the CHA root (a) to the bifurcation of the right and left hepatic arteries on the cephalic side (b) and to the right gastroepiploic artery and inferior pancreatic duodenal artery on the caudal side (c). The area surrounding by the dotted line(––) is mural thrombus. Angiography shows that the area indicated by the arrow(▽) is the route within the aneurysm.
PHA: Proper Hepatic Artery, CHA: Common Hepatic Artery, RHA: Right hepatic Artery,
LHA: Left Hepatic Artery, IPDA: Inferior Pancreaticoduodenal Artery,

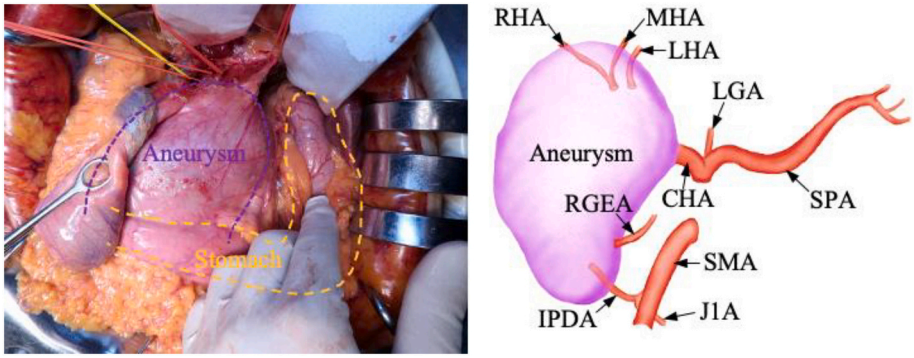

Fig. 2. The aneurysm originated in the common hepatic artery and extended to the proper hepatic artery, gastroduodenal artery, right gastroepiploic artery and inferior pancreaticoduodenal artery.
CHA: Common hepatic artery, SPA: Splenic artery, LGA: Left gastric artery, LHA: Left hepatic artery MHA: Middle hepatic artery, RHA: Right hepatic artery, RGEA: Right gastroepiploic artery
SMA: Superior mesenteric artery, IPDA: Inferior pancreaticoduodenal artery, J1A: First jejunal artery.

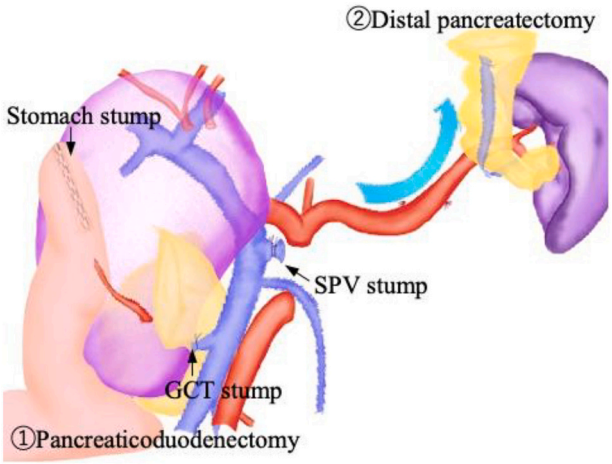

Fig. 3. ①At first a pancreaticoduodenectomy was performed.
②Due to construct by splenic artery transposition, a distal pancreatectomy with preservation of the splenic artery to the periphery was added. As a result, total pancreatectomy was performed. SPV: Splenic vein, GCT: Gastro colic trunk.

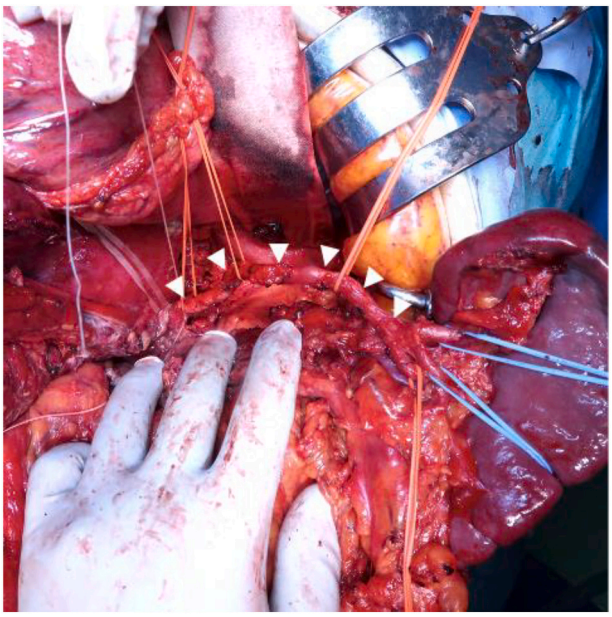

Fig. 4. A total pancreatectomy with preservation of the splenic artery(▽) to the periphery.

hemorrhage, while no postoperative hemorrhaging or occlusion was seen with splenic artery transposition. Although, regarding hepatic artery aneurysm resection, there are few case reports and small case series on hepatic artery reconstruction, there are many reports regarding resection and reconstruction of pancreatic cancer. According to Sakuraba et al. [23], of 35 cases of hepatic artery reconstruction (17 cases had end to end anastomosis, 14 cases had abdominal artery transfer, the others had graft bypass), the reconstructed artery was patent in 30 cases while occlusion or disruption was observed in only 5 cases. 2 of them was occurred in graft bypass. Graft bypass reconstruction had higher occlusion and complication rates than other reconstruction methods, most likely due to the two anastomoses required during interposition. Therefore, we recommend a single end-to-end anastomosis by transposition, if possible. Although there are reports of venous grafts, their long-term patency is worse than that of autologous arteries [24]. On the other hand, Erben et al. [4] reported that the 5-year patency rate of venous grafts was 86%. Among cases of graft occlusion, reconstruction was not always required because of the development of collateral pathways in cases of slow occlusion. Artificial blood vessels were once considered an unavoidable option in the absence of autologous veins; however, the non-inferior patency of heparin-coated artificial vessels (expanded polytetrafluoroethylene: ePTFE grafts) to venous grafts has been reported [25]. As the stability and patency of the arterial anastomosis was not a problem in this case, the choice of the splenic artery for hepatic artery reconstruction was optimal for caliber difference and reconstruction distance. The choice of splenic artery should therefore be considered a reliable option but there are also some reports on use of the left gastric or middle colonic arteries as autologous reconstructive arteries [26,27].

Secondly, total pancreatectomy avoids exposure to pancreatic juice at the anastomosis site due to pancreatic fistula, which is a complication specific to pancreatic resection. The incidence of postoperative pancreaticoduodenectomy in normal pancreatic patients has been reported to be 21.3% (8.9% for the International Study Group on Pancreatic Fistula (ISGPF) Grade A, 8.9% for Grade B, and 3.5% for Grade C) [28]. Since this complication has been reported to lead to pseudoaneurysm formation and massive bleeding, we had grave concerns that exposure of pancreatic juice to reconstructed vessels or vascular anastomoses could have led to fatal complications in the early postoperative period. If a pancreaticoduodenectomy is selected, it is easy to imagine that the close proximity of the pancreaticoduodenectomy to the vascular anastomosis will carry a high risk of pancreatic juice exposure. Essentially, there is a high possibility of massive hemorrhage from the failure of the anastomosis. Even if the failure of the anastomosis is avoided, stenosis and obstruction of the vascular anastomosis due to abscess and inflammation spreading around the pancreaticoduodenectomy are expected. In our case, the pancreas was clearly normal, and this forced us to weigh the risk of postoperative fatal complications due to disruption of the vascular anastomosis against the loss of QOL due to lifelong insulin therapy after total pancreatectomy. Here, we chose to avoid the greater

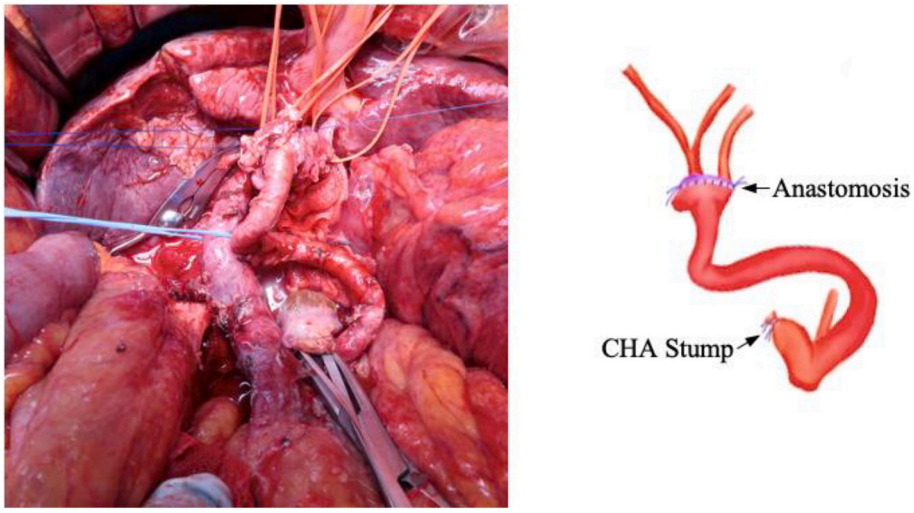

Fig. 5. A total of 12 cm of splenic artery was inverted to the right side and anastomosed end-to-end with the intrinsic hepatic artery using 5–0 PROLENE.

Table 1

Author	Era	Age	Sex	Location	Size	Operation	Reconstruction	Complication	Discharge	Patency
T.Luebke, et al.	2007	59	M	CHA-PHA/GDA	70 mm	Aneurysmectomy+IVR	None	None	7POD	
Yankovic W, et al.	2012	88	–	CHA	120 mm	Aneurysmectomy+IVR	None	None	8POD	
Nishibe M, et al.	2013	60	M	PHA	30 mm	Aneurysmectomy	GSV patch	None	–	2y patent
Odabasi M, et al.	2013	69	M	CHA-PHA/GDA	30 mm	Aneurysmectomy	SpA-RHA, CHA-LHA	None	–	1 m patent
Angiletta D, et al.	2015	64	M	CHA-PHA/GDA	140 × 130 mm	Aneurysmectomy+IVR	GSV + Dacron graft	None	6POD	1 m patent
Logaldo D, et al.	2016	73	M	CHA-PHA/GDA	30 × 36mm	Aneurysmectomy	SpA transposition	Cholangitis	24POD	3 m patent
Bacalbasa N. et,al	2017	68	–	CHA-PHA/GDA	–	Aneurysmectomy	None	None	–	
Lee D, et al.	2018	50	F	CHA-PHA/GDA	86 × 36mm	Aneurysmectomy	PHA-GDA(end to end)	None	9POD	
Imazuru T, et al.	2018	68	M	CHA-PHA	67 × 84mm	Aneurysmectomy	None	Cholecystitis&hepatic infarction	30POD	
Amato B, et al.	2020	76	F	CHA	34 × 42mm	Separation distal of Aneurysm	None	None	10POD	
Asano N, et al.	2020	70	F	CHA	110 × 90mm	Aneurysmectomy+IVR	None	None	12POD	3y patent
Rosenberg A, et al.	2020	41	M	GDA-PHA	30 mm	Aneurysmectomy	Femoral vein graft	22POM:duodeno-hepatic arterioenteric fistula→jumping graft(Ao-HA)	–	3 m patent
“	2020	56	M	GDA-PHA	50 mm	Aneurysmectomy	SpA transposition	None	–	
Graham I, et al.	2021	69	M	CHA-PHA	29 mm	Aneurysmectomy	Dacron graft	None	5POD	6 m patent
Our case	2022	65	F	CHA-PHA/GDA	120 mm	Aneurysmectomy+IVR	SpA-RHA/LHA	None	21POD	2y patent

CHA: Common hepatic artery, PHA: Proper hepatic artery, SpA: Splenic artery, GDA: Gastroduodenal artery, RHA: Right hepatic artery.
LHA: Left hepatic artery, GSV: Great saphenous vein, POM: Post operative month, Ao: Aorta, HA: Hepatic artery.

of two negative outcomes. Most reported cases of pancreaticoduodenectomy with hepatic artery reconstruction (with pancreatic-enteric anastomosis) are cases of pancreatic cancer with sclerosing pancreases and the frequency of pancreatic fistulas in those cases is extremely low [29]. In view of the above, we believe that splenic artery for hepatic artery reconstruction and total pancreatectomy is a useful technique for vascular anastomosis stability and avoidance of postoperative complications.

Recently, endovascular treatment, depending on the location and size of the hepatic aneurysm, has been increasingly utilized as Driscoll et al. [6] and Abbas et al. [30] reported coil embolization of the common hepatic artery and branches of the intrahepatic artery. Meanwhile, Larson et al. [31] reported that aneurysms confined to the common hepatic artery do not require revascularization if an adequate collateral pathway to the hepatic artery via the gastroduodenal artery is confirmed preoperatively. In such cases, coil embolization can be performed safely and without complications. Ferrero et al.5) reported stent endarterectomy for common hepatic aneurysms. As such, patients who previously required revascularization by laparotomy can be treated by endovascular therapy alone if conditions are favorable. On the other hand, resection is indicated in cases of large hepatic aneurysms or complicated vascularization. Erben et al. [4] reported that they abandoned attempted stent endarterectomy because of the tortuous nature of the vessel and instead performed laparotomy for revascularization using the great

saphenous vein. Since open surgery is the best option in some cases, HAA treatment should be determined according to anatomical features and thus reoperative angiographic evaluation of morphology and collateral pathways is important. The Society for Vascular Surgery clinical practice guidelines on the management of visceral aneurysms published in 2020 also emphasize the importance of preoperative angiography (recommendation grade A [strong]) [32]. If endovascular treatment is judged to be difficult, aneurysm resection and arterial reconstruction are required.

4. Conclusion

Although most hepatic aneurysms are treated by endovascular therapy, there are cases in which aneurysm resection and reconstruction by laparotomy is necessary, as in our case, splenic artery transposition for HAA is advantageous in adjustability of the caliber difference and securing of sufficient distance. In addition, total pancreatectomy may be acceptable in patients with a normal pancreas to avoid fatal complications such as disruption of the anastomosis and reconstructed artery due to pancreatic juice exposure.

Consent

Written informed consent was obtained from the patient for publication of this case report and accompanying images. A copy of the written consent is available for review by the Editor in Chief of this journal on request.

CRediT authorship contribution statement

Koichiro Kumano carried out revision of the manuscript. Shinji Hashimoto is the corresponding author and All authors read, supervised the writing of the manuscript and approved the final manuscript.

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This report is not research study.

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Declaration of competing interest

None.

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