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Case Report

Hepatic artery pseudoaneurysm after pancreaticoduodenectomy treated with coil embolization in combination with portomesenteric venous stenting

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A B S T R A C T

Delayed massive hemorrhage after pancreaticoduodenectomy is known as a fatal complication, frequently caused by gastroduodenal artery stump bleeding or hepatic artery pseudoaneurysm. Transarterial hepatic artery embolization is one of the treatment options in such cases. However, hepatic artery embolization can also result in ischemic complications of the liver, even fatal sometimes. We report a case of a 70-year-old male patient with distal common bile duct cancer who underwent pancreaticoduodenectomy. After three weeks, there was a bloody drain component accompanied with a decreased hemoglobin level. The immediate computed tomography scan and subsequent angiography demonstrated a hepatic artery pseudoaneurysm (1.8 cm in size) with segmental narrowing of the portal vein and superior mesenteric vein. The pseudoaneurysm and common hepatic artery were embolized using microcoils, following percutaneous portomesenteric stenting. There was no such ischemic complication as hepatic infarction after the procedure, and the patient was well tolerable. We suggest that the simultaneous portomesenteric stenting prior to hepatic artery embolization may be helpful to reduce the risk of hepatic infarction/failure in a patient with hepatic artery pseudoaneurysm accompanying portomesenteric vein stenosis after pancreaticoduodenectomy.

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Introduction

Delayed massive arterial hemorrhage is a rare but life-threatening complication in patients after pancreaticoduodenectomy (PD), of which the mortality is known to reach 50%.^{1–7} This fatal complication is caused by pseudoaneurysm rupture as a result of vascular erosion, associated with localized infection or pancreatic juice leakage from the pancreatic anastomosis site.⁸ In particular, the common hepatic artery and the gastroduodenal artery (GDA) stump are often involved due to its anatomic location, which is located near pancreaticojejunostomy or hepaticojejunostomy.⁷ The surgical management after postoperative hemorrhage has a low success rate due to postoperative adhesion and is associated with high mortality and morbidity.^{5,9} Therefore, therapeutic transarterial embolization or endovascular-covered stent insertion has been the first-line therapy for delayed postoperative hemorrhage after PD.^{3–5,10–12} With respect to hepatic artery embolization, despite its

decent result in bleeding control, many unfavorable outcomes such as hepatic infarction or hepatic failure have been reported in previous studies.^{1,7,8} In addition, portal vein (PV) and superior mesenteric vein (SMV) stenoses are known to occur occasionally in patients who underwent pancreato-biliary surgery, which can hinder the blood flow into liver and make the liver susceptible to ischemia.^{13,14}

We present a case of hepatic artery pseudoaneurysm accompanying PV-SMV stenosis after PD treated with hepatic artery coil embolization in combination with portomesenteric venous stenting.

Case Report

A 70-year-old male patient with distal common bile duct cancer underwent PD. Because the patient complained of abdominal pain accompanied with vomiting and fever two weeks

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after surgery, an abdominal computed tomography (CT) scan was taken. On the CT scan, there was a large amount of complicated fluid collection in the peripancreatic space and around the SMV that was thought to be the result of leakage from pancreaticojejunostomy. There was no evidence of active bleeding or pseudoaneurysm formation at the time, but only mild segmental stenosis ($< 50\%$) at the proximal SMV. Since the patient was referred to the interventional radiology department for peripancreatic fluid drainage, an 8.5-F multi-side hole drainage catheter (Cook Medical, Bloomington, IN, USA) was inserted under fluoroscopic guidance. The patient's laboratory test, which was taken on the eighth day after drainage catheter insertion, showed a decreased hemoglobin level, 9.0 mg/dL to 7.0 mg/dL, and there was bloody drainage component through the hemovac catheter, so subsequently, the patient underwent repeated abdominal CT scan. The CT scan depicted an approximately 1.8 cm sized pseudoaneurysm formation in the proper hepatic artery in addition to aggravated stenosis ($> 90\%$) of the SMV with surrounding complicated fluid collection (Fig. 1). Surgical treatment was judged to be difficult because of postoperative adhesion. Furthermore, since there was no available appropriate-sized covered stent in our institution, emergency angiography and subsequent hepatic artery embolization were planned. The preprocedural laboratory test showed normal values of aspartate aminotransferase (AST): 34 IU/L and alanine aminotransferase (ALT): 29 IU/L. An elevated level of total bilirubin level; 3.69 mg/dL was also found, which was thought to be the result of cholestasis from the postoperative edematous change at hepaticojunctionostomy site. However, the preprocedural CT scan showed segmental narrowing of the SMV; therefore, we expected that ischemic liver injury could occur after hepatic artery embolization, which results from the significantly diminished blood supply to the liver parenchyme. Accordingly, we also arranged additional portomesenteric vein stenting before hepatic artery embolization to avoid possible complications of ischemic liver injury.

After the anterior PV was punctured using a 21-gauge needle, we placed a 6-F vascular sheath (Boston Scientific, Marlborough,

MA, USA) into the portal system. Following vascular sheath placement, a 5-F angiographic catheter was advanced with 0.035 inch guidewire into the SMV. Transhepatic portography demonstrated segmental narrowing of the proximal main PV and SMV, which correlated with the CT findings. We inserted a 12 mm $\times$ 6 cm sized bare-metal stent (Epic; Boston Scientific) across the PV and the SMV. After stent placement, portography showed the improved portal flow and the extended diameter of both the PV and SMV (Fig. 2). The tract embolization was achieved using the mixture of *N*-butyl cyanoacrylate and lipiodol.

After the stenting, we performed diagnostic celiac angiography with a 5-F angiographic catheter (RH catheter; Cook Medical) via a transfemoral route. The celiac angiography showed a pseudoaneurysm with the beaded appearance in the common/proper hepatic artery, and there was no anatomic variation of the hepatic arteries. After identifying the pseudoaneurysm, we placed microcoils (Concerto; Medtronic, Minneapolis, MN, USA/Nester; Cook Medical) in the hepatic artery, proximal and distal to the pseudoaneurysm. After embolization, celiac angiography showed the pseudoaneurysm totally disappeared (Fig. 2). And selective right inferior phrenic artery angiography depicted a connection between the right inferior phrenic artery and the right posterior hepatic artery (Fig. 3A).

During the first day after embolization, the level of AST, ALT, and total bilirubin were elevated to 647 IU/L (AST), 249 IU/L (ALT), and 4.35 mg/dL (total bilirubin), and normalized after ten days. A follow-up abdominal CT scan was obtained six days after hepatic artery embolization. The CT scans demonstrated pseudoaneurysm completely disappeared in the hepatic artery with preserved flow and perfusion of the intrahepatic arteries (Fig. 3B). Furthermore, there was only a mild ischemic change in segment V of the liver, around the embolized PV puncture tract. The patient had a decent subsequent recovery without evidence of recurrent bleeding or hepatic infarction/failure.

Fig. 1. (A) The abdominal computed tomography (CT) scan, which was performed two weeks after pancreaticoduodenectomy demonstrated complicated fluid collections in the peripancreatic space and around the superior mesenteric vein (SMV) (arrowhead). (B) Short segmental stenosis of the SMV was noted (arrow). (C) The drain catheter was inserted under fluoroscopic guidance. (D) CT scans obtained a week after the drain catheter insertion showed pseudoaneurysm at the proper hepatic artery (arrowhead).

Fig. 2. Angiography findings during the procedure. (A) Transhepatic portomesenteric venography revealed segmental stenosis of the superior mesenteric vein (SMV) and the proximal main portal vein (PV). (B) After the placement of the stent, the diameter of SMV and proximal main PV was extended with the good hepatopetal flow. (C) Common hepatic angiography showed a pseudoaneurysm formation in the proper hepatic artery (arrowhead). Note the normal appearance of the GDA stump (arrow). (D) Postembolization angiography confirmed the complete occlusion of common hepatic artery and pseudoaneurysm.

Fig. 3. (A) Right inferior phrenic angiography after hepatic artery embolization depicted collateral vessels to the liver parenchyma (arrow). (B) The abdominal computed tomography scans six days after embolization demonstrated the pseudoaneurysm thoroughly disappeared with preserved flow to the intrahepatic arteries (arrowhead).

Discussion

We report a case of hepatic artery pseudoaneurysm accompanying stenosis of PV-SMV after PD which was successfully treated with transarterial coil embolization of hepatic artery and simultaneous portomesenteric stenting.

The liver is known to be relatively safe from ischemic injury due to a dual supply from the PV, hepatic artery, and extensive collateral pathways. However, the risk of ischemic liver injury arising from hepatic artery embolization can be increased after PD due to ligation of collateral vessels during the operation and accompanying PV stenosis.^{5,15} In other words, the development of hepatopetal collateral vessels after hepatic artery embolization is associated with the prevention of hepatic infarction, whereas accompanying PV stenosis is associated with poor prognosis and hepatic failure onset.^{6,7} With regard to PV stenosis, a recent study by Ohgi et al¹⁶ showed that postoperative pancreatic juice leakage

and intra-abdominal abscess were the risk factors for PV stenosis after PD, which was thought to result from local inflammation-associated fibrotic adhesion. On the preprocedural CT of this patient, segmental stenosis of SMV with surrounding complicated fluid collection was observed, which could lead to a risk of the decreased PV flow. Therefore, we obtained the hepatopetal portal flow by portomesenteric venous stenting prior to arterial embolization. Furthermore, a collateral supply to the hepatic artery was observed on the right inferior phrenic artery angiography after hepatic artery embolization.

In fact, there was only a mild elevation of liver enzymes, which was normalized after one week. When there is bloody drainage or gastrointestinal tract hemorrhage after PD, it is called the 'sentinel bleeding,' which was reported by Brodsky and Turnbull.¹⁷ If such warning blood is present, a massive major hemorrhage may occur after six hours to ten days, so early angiography or CT is suggested.¹ In addition, the risk of liver failure after

hepatic artery embolization may be higher when the PV flow significantly diminishes after hypovolemic shock caused by massive hemorrhage.⁸ In this case, the patient immediately underwent CT scans when the bloody drain component was detected; therefore, the pseudoaneurysm was detected and treated before hypovolemic shock or coagulopathy occurred. In this regard, the patient's liver was considered to be more tolerable to ischemic stress.

In conclusion, for patients with massive hemorrhage or pseudoaneurysm formation in the GDA stump or the common hepatic artery after PD, hepatic artery embolization is the first-line treatment. However, the risk of hepatic failure can be increased when there is an accompanying SMV or PV stenosis. Therefore, in such patients, simultaneous portomesenteric stenting prior to hepatic artery embolization may be helpful to reduce the risk of hepatic infarction/failure after hepatic artery embolization, but further studies are needed to establish its efficacy.

Conflicts of Interest

No potential conflict of interest relevant to this article was reported.

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