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## Case Report

# Percutaneous transhepatic coil and cover technique with small system for the extrahepatic portal vein hemorrhage after pancreaticoduodenectomy

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## ABSTRACT

Post-pancreaticoduodenectomy hemorrhage is a life-threatening complication that usually occurs in skeletonized arteries. Venous hemorrhage is a rarer complication, and surgical management is often challenging. We herein report the case of an 80-year-old man who suffered from prolonged pancreatic fistula and long-term drainage tube placement, which could cause late post-pancreaticoduodenectomy hemorrhage from the confluence of the splenic and extrahepatic portal veins. An intrahepatic posterior portal venous branch was percutaneously punctured, and the splenic vein was embolized using coils and a vascular plug. A balloon-expandable covered stent was also placed from the superior mesenteric vein to the main portal vein to cover the confluence, which required a system as small as 8-F. Portal venography revealed good patency without extravasation. Thereafter, antithrombotic and antibacterial treatments were successfully administered without any additional interventions. He remained well without any evidence of thrombosis or indolent infection 19 months after endovascular treatment. The endovascular coil and cover technique with prolonged adjuvant therapy is a feasible alternative for managing such critical situations.

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## Introduction

Pancreaticoduodenectomy (PD) is a complex, high-risk surgical procedure that resects lesions arising from the periampullary area and pancreatic head. The mortality rate associated with PD has significantly decreased; however, the mor-

bidity rate remains high. We present the case of an 80-year-old man who underwent PD and had a prolonged pancreatic fistula, hepatic artery hemorrhage on postoperative day 9, and extrahepatic portal vein hemorrhage on postoperative day 49. Both bleeding episodes were successfully treated using an endovascular approach.

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**Fig. 1 – Contrast-enhanced computed tomography scan shows extravasation in the jejunum (arrows).**

## Case report

An 80-year-old man underwent PD for pancreatic head carcinoma stage ycT4N0M0, where portal vein resection was not required to achieve complete tumor extirpation. Imanaga reconstruction was performed [1]. Two drainage tubes were placed intraoperatively on both anterior and posterior sides of the pancreatic-jejunal anastomosis. The ratio of the amylase in the drain to the serum, which was measured on postoperative day 3, revealed pancreatic-jejunal anastomotic leakage. On postoperative day 8, the patient developed sentinel bleeding from the drainage tubes. He remained hemodynamically stable, and angiography was performed the next day. Since the angiogram revealed an irregular vascular wall, the left hepatic artery and a replaced right hepatic artery from the superior mesenteric artery were both embolized using microcoils.

The pancreatic fistula and intermittent high-grade fever persisted, and irrigation with normal saline through the drainage tubes was regularly performed, along with tube exchange and contrast tests. A dynamic computed tomography (CT) performed on the postoperative day 34 revealed air density in the intrahepatic portal vein; however, there were no findings of extravasation.

On postoperative day 49, to exchange the drainage tube, traction was placed on the tube, and a contrast medium was injected via the tube. The contrast showed a small peritoneal cavity due to a pancreatic-jejunal anastomotic leakage, as well as the main portal vein, which indicated portal vein injury. The tube was immediately clamped, and conservative hemostasis was initiated. On postoperative day 54, he had melena and his blood pressure decreased to 86/56 mmHg. A dynamic enhanced CT scan revealed extravasation in the jejunum in the delayed phase (Fig. 1). Subsequently, the patient was urgently transferred to the angiography room.

An arteriogram revealed no significant extravasation or pseudoaneurysms; however, splenic venous return showed mild extravasation. The intrahepatic posterior portal venous branch was punctured using an ultrasound-guided transhepatic approach, and a 6-F sheath was inserted into the main portal vein. A splenic venogram revealed extravasation from

the confluence of the splenic and superior mesenteric veins (SMV) (Fig. 2A). The SMV was stenosed and kinked (Fig. 2B). A 0.035 in stiff 300 cm guidewire (Radifocus M; Terumo, Tokyo, Japan) was placed in the SMV, and then a 6-F sheath was exchanged for an 8-F sheath and placed in the main portal vein. A 4-F headhunter-shaped catheter was inserted in the splenic vein, and embolization was performed using 12 mm/20 cm and 10 mm/20 cm coils (Interlock; Boston Scientific, Marlborough, MA), and an 8 mm vascular plug (AMPLATZER Vascular Plug IV; Abbott Cardiovascular, MN). Subsequently, an 8-F sheath was advanced toward the SMV, and a covered stent (GORE, VIABAHN, VBX Balloon Expandable Endoprosthesis; W. L. Gore & Associates, Flagstaff, AZ) was placed from the superior mesenteric vein to the main portal vein to cover the confluence (Fig. 2C). Portal venography revealed good patency (Fig. 2D), and arteriography showed no splenic venous return. At the end of the procedure, a 5 mm/10 cm coil (Interlock; Boston Scientific, Marlborough, MA) was used to close the punctured hepatic tract.

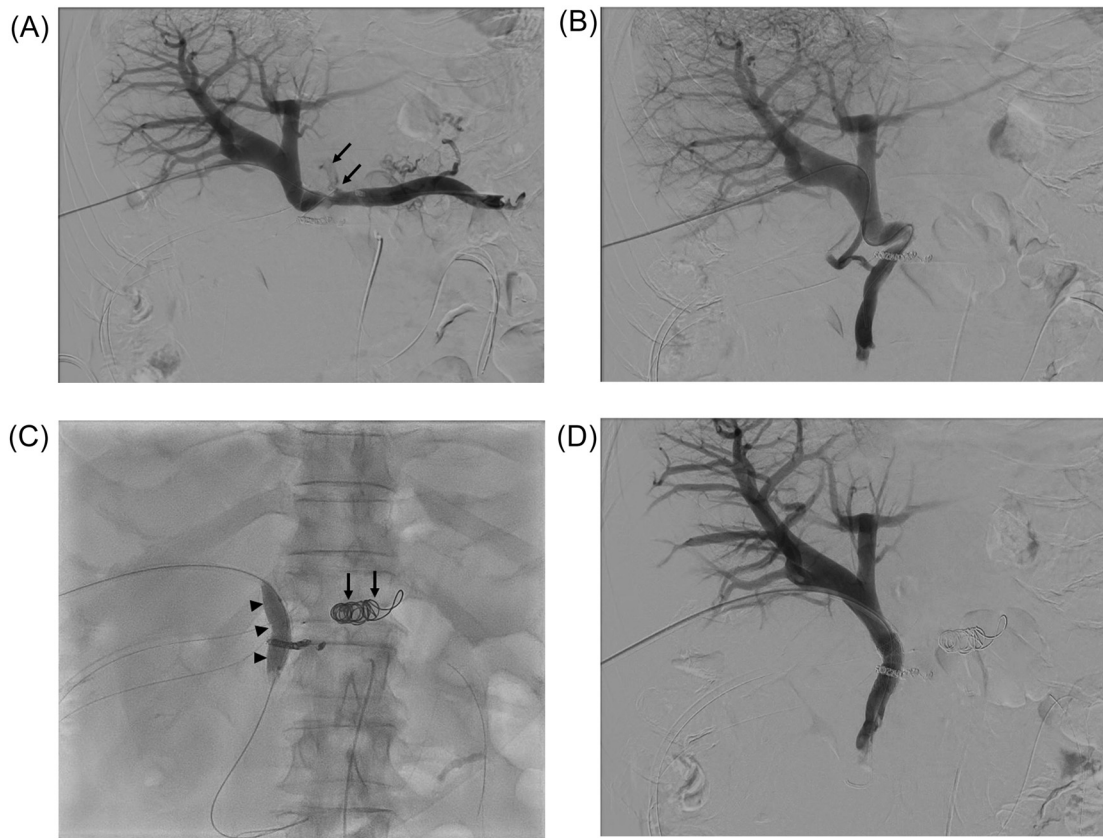
Thereafter, no significant hemorrhage was observed, and intravenous antibiotics, which were effective against the bacteria cultured from the drain discharge, were administered for 3 weeks after the placement of the covered stent. The pancreatic fistula gradually improved, and the patient was discharged on postoperative day 148. A follow-up CT-ultrasound fusion imaging performed 18 months after placement of the covered stent revealed good patency (Fig. 3). The patient remained well without any evidence of indolent infection 19 months after the covered stent treatment.

## Discussion

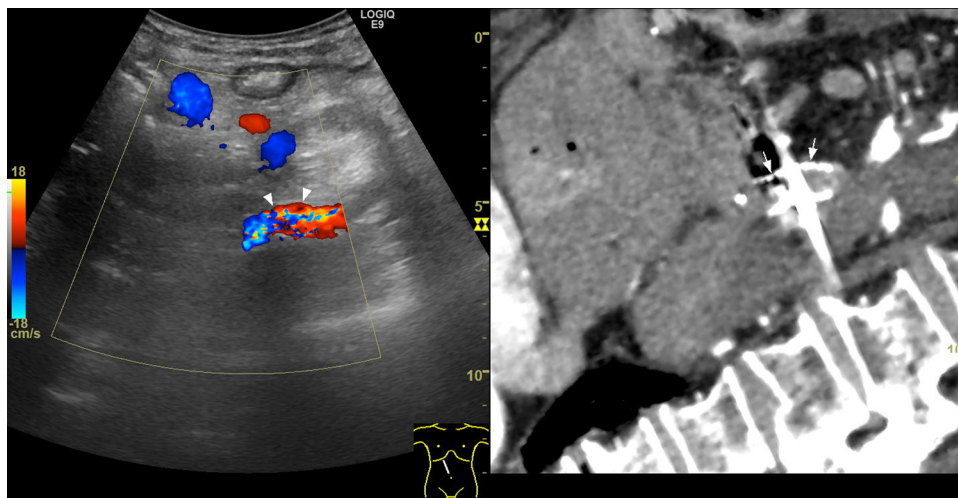
The mortality rate associated with PD has significantly decreased to less than 4% over the past decades; however, postoperative morbidity remains high at 40%-50% even in high-volume centers [2–4]. Post-pancreaticoduodenectomy hemorrhage (PPH) is a life-threatening complication, and a consensus definition of PPH was proposed by the International Study Group of Pancreatic Surgery in 2007 [5]. Delayed PPH can be caused by several mechanisms, such as pancreatic fistula, skeletonization of vessel walls, local infection including abscess formation, and continuous irritation with a drainage tube [6,7]. Our patient had a prolonged pancreatic fistula and bowel anastomotic leakage. As a result, drainage tubes could not be removed for a long time, which could cause late PPH from the extrahepatic portal vein, leading to the melena through jejunal anastomotic leakage.

Recently, covered stent placement and coil embolization have been accepted treatments for arterial hemorrhage after PD, even in the case of infection. These treatments could be the first choice of management if the anatomical condition is suitable [8,9]. However, extrahepatic portal vein hemorrhage after PD is rare, and the standard management is still surgical repair [10–13], which could be challenging due to the possibility of severe adhesion.

Endovascular management requires a transhepatic or trans-ileocolic venous approach for venous hemorrhage, such



**Fig. 2 – (A) Splenic venography reveals extravasation from the confluence of the splenic and portal veins (arrows). A drainage tube is right behind the confluence. (B) Superior mesenteric venography shows stenosis and kinking. (C) The splenic vein is embolized (arrows) and a covered-stent is placed from the superior mesenteric vein to the portal vein (arrowheads). (D) Portal venography reveals good patency without any extravasation.**



**Fig. 3 – Virtual computed tomography image (right) and corresponding real-time ultrasound image (left). Arrows show a covered stent and corresponding arrowheads show good patency.**



as the portal vein or the SMV. The latter still requires open surgery, and a large sheath insertion could be a problem. The transhepatic approach can also be problematic since it utilizes a large sheath as well, especially under abnormal coagulation conditions. Several similar cases have been reported, all of which were performed using the transhepatic approach, and one case required a 12-F sheath to insert a covered stent. A balloon-expandable covered stent, Gore Viabahn VBX, which was approved for iliac artery stenotic disease in Japan in 2018, could be inserted using smaller systems. An 8-F sheath was used to insert a 10 × 29 mm VBX graft, which was advantageous for the transhepatic approach in such a critical situation.

The long-term patency of covered stents for venous systems remains unclear, and the use of adjuvant antithrombotic drugs remains controversial. Dual antiplatelet therapy or anticoagulation therapy has been recommended after covered balloon-expandable stent placement for peripheral arterial disease [14,15]; however, there is no definitive recommendation for the use of Gore Viabahn VBX, especially for venous usage. Our patient was taking a combination of a single antiplatelet drug (clopidogrel, 75 mg daily) and a direct oral anticoagulant drug (edoxaban, 30 mg daily). At 19 months after the surgery, he had no bleeding or graft thrombosis. The combination of antiplatelet and anticoagulant therapy could be a reasonable form of adjuvant therapy for covered stents in the venous system [16–19].

The use of covered stents for managing infected sites is still controversial, although several reports have noted its efficacy and feasibility. Prolonged antibiotics should be administered depending on each case [20–25]. Our patient had 3 weeks of intravenous antibiotics, which were effective against the germ cultured from the drain discharge, and had prolonged oral antibiotics as well. No evidence of indolent infection was noted at 19 months after the surgery.

The findings from our case highlight the rarity of extrahepatic portal vein hemorrhage after PD and the efficacy of a percutaneous transhepatic coil and cover strategy with a small system followed by appropriate antithrombotic and antibiotic therapy.

## Conclusion

We observed a rare case of extrahepatic portal vein hemorrhage after PD. A percutaneous transhepatic coil and cover strategy with prolonged antithrombotic and antibiotic treatment may be a feasible alternative to treat such critical conditions.

## Patient consent

Written informed consent was obtained from the patient for the publication of this report and any accompanying images.

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