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Case Report

Delayed Arterial Hemorrhage After Pancreaticoduodenectomy

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Delayed arterial hemorrhage is a rare complication of pancreaticoduodenectomy that is associated with a high mortality and has no standard management. Between 2000 and 2011, 204 pancreaticoduodenectomies were performed, and there were 3 cases of delayed arterial hemorrhage. We reviewed the role of endoscopy, laparotomy, and interventional radiology the management of delayed hemorrhage. One patient presented with intraluminal bleeding and upper gastrointestinal endoscopy failed to identify the bleeding site. Two patients presented with bleeding from the drain tube. Laparotomy was performed in the patient with intraluminal bleeding and interventional radiology was employed for the other 2 patients. There was no hemorrhage-related mortality or rebleeding, but the patient who underwent laparotomy developed sepsis. Endoscopy may have no role in the initial management of delayed arterial hemorrhage after pancreaticoduodenectomy. Interventional radiology is less invasive compared with laparotomy, and may be considered as the first-line treatment for delayed arterial hemorrhage in pancreaticoduodenectomy patients.

Key words: Pancreaticoduodenectomy – Postoperative hemorrhage – Interventional radiology

The mortality rate of patients undergoing pancreaticoduodenectomy (PD) has decreased in recent decades, but complications still occur at a high rate of 30% to 50%.[1–5] Common complications of PD include pancreatic leakage, delayed gastric emptying, and intra-abdominal abscess. Hemorrhage only has an incidence of 2%–4%, but this complication is associated with a high mortality rate of 11% to 54%.[1–3] Because delayed hemorrhage is uncommon after PD, its management remains unclear. Here we present our experience with this complication and review the available therapeutic strategies.

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Patients and Methods

Between 2000 and 2011, 204 patients with pancreatic head tumors underwent PD at our institution. All patients underwent an end-to-side, 2-layer pancreaticojejunostomy using a mucosa-to-mucosa anastomosis. Among these 204 patients, three (1.5%) developed massive postoperative arterial hemorrhage, which was defined as major bleeding more than 24 hours after PD from the abdominal drain tube or gastrointestinal tract that required transfusion of at least 4 units of packed red cells within 24 hours after its onset. Postoperative pancreatic fistula was classified according to the criteria of the International Study Group on Pancreatic Fistula (ISGPF).[6] The detailed clinical course of the 3 patients was investigated and the findings are summarized next.

Results

Case 1

A 67-year-old woman underwent pylorus-preserving pancreaticoduodenectomy (PPPD) for pancreatic head carcinoma. There was active bleeding from the wall of the bile duct before hepatico-jejunostomy, but hemostasis was achieved afterward. On the 21st postoperative day, she had an episode of hematemesis and melena, but was hemodynamically stable. Upper gastrointestinal endoscopy revealed a fibrin cap at the hepaticojejunal anastomosis. We suspected that this was the site of hemorrhage, but we did not perform any treatment because it was no longer bleeding. Colonoscopy did not reveal any pathology. Four days later, she collapsed while passing a massive melena. Upper gastrointestinal endoscopy demonstrated an elevated jejunum full of fresh blood, but the origin of the bleeding could not be identified. Because her hemodynamics were unstable, the decision was made to proceed immediately to laparotomy. Arterial bleeding was detected from the hepaticojejunal anastomosis after the jejunum was opened (Fig. 1). Then disruption of the pancreaticojejunal anastomosis occurred. It proved impossible to repair the anastomosis, so we performed drainage. Hemostasis was achieved by suturing the bleeding site at the hepaticojejunal anastomosis. Postoperatively, the patient was managed in the intensive care unit (ICU) for 4 days. There was no further bleeding, but she developed sepsis, a fistula due to leakage from the pancreaticojejunostomy, wound infection, and an intra-abdominal abscess. This patient eventually recovered and the fistula was closed by itself, after which she was discharged on the 83rd postoperative day.

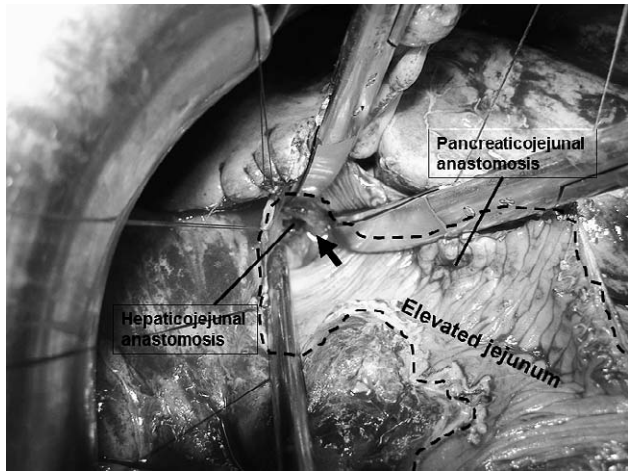

Fig. 1 Laparotomy reveals bleeding from the hepaticojejunal anastomosis (arrow) after opening the elevated jejunum.

Case 2

A 74-year-old man underwent PPPD for adenocarcinoma of the minor duodenal papilla. Surgery revealed severe adhesions that were attributable to partial resection of the duodenum for a duodenal polyp 1 year earlier. The patient developed a grade A pancreatic fistula due to leakage at the pancreaticojejunal anastomosis. On the 15th postoperative day, the abdominal drain bottle was found to contain 700 mL of blood. He was hemodynamically stable, but the decrease of hemoglobin required blood transfusion with 4 units of packed red cells. Angiography demonstrated active bleeding from the right gastric artery without any sign of an aneurysm (Fig. 2A). This vessel was selectively catheterized and coils were placed in the common hepatic artery for embolization (Fig. 2B). He did not need to spend time in the ICU after this procedure and complete hemostasis was achieved without impairment of liver function. He subsequently developed intra-abdominal infection which was treated with antibiotics. He recovered and was discharged on the 59th postoperative day.

Case 3

A 66-year-old man underwent PPPD for middle bile duct carcinoma. He developed a grade B pancreatic fistula due to leakage at the pancreaticojejunal anastomosis and intra-abdominal infection, but

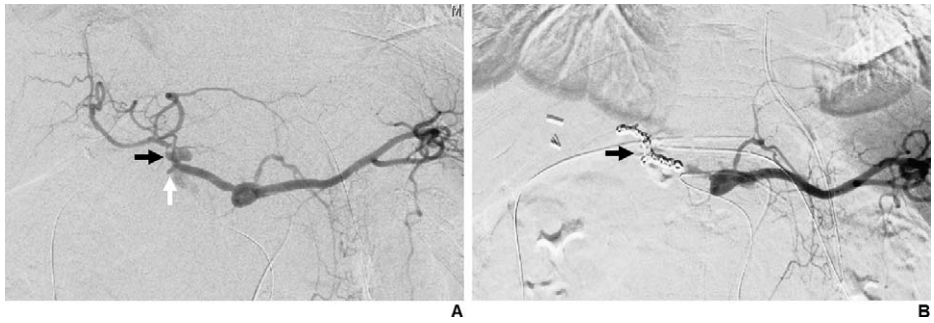

Fig. 2 Interventional radiology in Case 2. (A) Celiac axis angiogram demonstrates extravasation from the right gastric artery (black arrow). The stump of the gastroduodenal artery is indicated by the white arrow. (B) Complete hemostasis was obtained with multiple coils (arrow).

was treated conservatively with antibiotics. On the 12th postoperative day, blood was discharged through the abdominal drain tube. He was hemodynamically stable, but his hemoglobin declined and blood transfusion (4 units) was required. Angiography demonstrated bleeding from the third branch of the jejunal artery (Fig. 3A**)**. This vessel was selectively catheterized and embolization was done with gelatin sponge pledgets **(**Fig. 3B**)**. He did not need management in the ICU and complete hemostasis was achieved without necrosis of the jejunum. He subsequently developed anorexia and an intra-abdominal abscess resulted from infection of hematoma. We performed percutaneous abscess drainage for intra-abdominal abscess and treated with antibiotics. He was eventually discharged on the 145th postoperative day.

Discussion

The most frequent complications of PD are pancreatic leakage, delayed gastric emptying, and intra-abdominal abscess. Hemorrhage is reported less frequently after PD, with its incidence ranging from 2% to 4%, but this complication is associated with a high mortality rate of 11% to 54%.[1–3]

Despite the severe consequences of hemorrhage after PD, neither a classification nor a treatment protocol has been established. The most systematic effort to classify hemorrhage after PD was made by

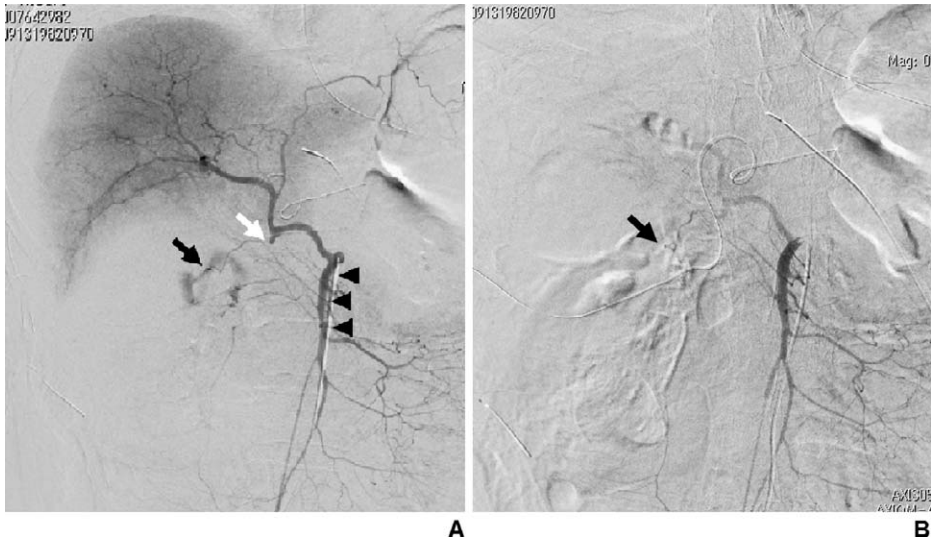

Fig. 3 Interventional radiology in Case 3. (A) Superior mesenteric artery angiogram shows extravasation from the third branch of the jejunal artery (black arrow). The stump of the gastroduodenal artery is indicated by the white arrow and the superior mesenteric artery is shown by arrowheads. (B) Complete hemostasis was obtained by using gelatin sponge (arrow).

Table 1 Details of the 3 cases of delayed arterial hemorrhage after pancreaticoduodenectomy

Case No.	Age (yrs)	Sex	ISGPF	Time to hemorrhage after PD (days)	Presentation	Cause of hemorrhage	Management	Time in ICU (days)	Complications	Sepsis	Time to discharge after PD (days)
1	67	Female	(−)	25	Melena	Incomplete hemostasis of the bile duct	Laparotomy	4	Pancreatic fistula, wound infection, intra-abdominal abscess	(+)	83
2	74	Male	A	15	Blood in drain	Surgical dissection weakening of the arterial wall, Pancreatic fistula	IR	0	Intra-abdominal infection	(−)	59
3	66	Male	B	12	Blood in drain	Pancreatic fistula	IR	0	Intra-abdominal infection, anorexia	(−)	145

IR, interventional radiology.

the International Study Group of Pancreatic Surgery (ISGPS).[7] According to the proposed consensus, hemorrhage after PD should be categorized with respect to the time of onset ("early" at less than 24 h or "delayed" at 24 h or longer), location (intraluminal or extraluminal), and severity (grade A, B, or C). The timing of onset is important because early hemorrhage has a different etiology and management compared with delayed hemorrhage. Early hemorrhage is generally caused by technical failure and normally requires immediate laparotomy for management.[8] Delayed hemorrhage is any bleeding after the initial 24 h period and there are multiple possible causes.

In our series of 204 PDs, there were 3 cases of delayed arterial hemorrhage (1.5%). It cannot draw too many strict conclusions from 3 cases.

The characteristics, clinical presentation, management, and outcome of these patients are summarized in Table 1. The timing of delayed arterial hemorrhage is variable, but the mean time of onset was the 17th postoperative day in our series. A pancreatic fistula was also present in 2 patients (grade A in Case 2 and grade B in Case 3). Case 1 presented with intraluminal bleeding, while Cases 2 and 3 had extraluminal bleeding.

Multiple factors have been suggested to contribute or predispose to the occurrence of delayed arterial hemorrhage after PD, such as the performance of regional lymphadenectomy and skeletonization of the vasculature, which render the vessels vulnerable to damage due to local sepsis arising from pancreatic fistula, anastomotic leakage, or abscess formation.[9] In our series, the cause of arterial hemorrhage in Case 1 was considered to be incomplete hemostasis of the bile duct during PPPD because of the large number of bleeding points. The cause of hemorrhage in Case 2 was considered to be weakening of the walls of the bleeding artery by surgical dissection because of severe adhesions and to be pancreatic fistula. In Case 3, arterial hemorrhage was considered to be secondary to a pancreatic fistula with intra-abdominal infection. We believed that the bleeding at that point could be related to the existence of pancreatic fistula in Case 2 and Case 3.

Endoscopy is established as the first-line diagnostic option for upper gastrointestinal bleeding. Although several studies have supported the role of upper gastrointestinal endoscopy for suspected gastrointestinal hemorrhage, recent experience has revealed that endoscopy, despite being diagnostic, can be misleading and tends to delay definitive treat-

ment, with death occurring in the worst case.[10–12] In our series, Case 1 had intraluminal bleeding. Upper gastrointestinal endoscopy demonstrated an elevated jejunum full of fresh blood, but the site of bleeding could not be identified. Therefore, we consider that endoscopy may have no role in the initial management of delayed arterial hemorrhage after PD.

Angiography is currently gaining favor in the treatment of postoperative hemorrhage. Use of angiography combined with embolization is widely documented and has achieved favorable results.[9,11,12] However, angiography has limitations such as not detecting the source of bleeding when the origin is venous, diffuse, or intermittent.[13]

In our experience, we believed that endoscopic management may be inferior to the use of interventional radiology for delayed arterial hemorrhage after PD. But hemostasis was achieved by endoscopic management in reported cases.[14] When it does not have a very strong interventional radiology department in hospital, endoscopic treatment may be attempted for delayed arterial hemorrhage after PD.

Laparotomy is still considered to be the gold standard for management of hemorrhage after PD and remains the only option for an unstable, rapidly deteriorating patient or after failed angiography. At laparotomy, hemostasis is achieved by ligation and this can be combined with treatment of factors contributing to delayed arterial hemorrhage, such as anastomotic leakage or abscess. Based on the published literature, laparotomy and interventional radiology appear to be equally effective for controlling hemorrhage. In our series, Case 1 underwent laparotomy and complete hemostasis was achieved, while hemostasis was achieved with interventional radiology in Cases 2 and 3.

A higher morbidity and mortality has been reported for patients managed by laparotomy compared with interventional radiology. In our series, admission to the ICU was required for Case 1 who underwent laparotomy, while a stay in ICU was not required for Cases 2 and 3 who were managed by interventional radiology. Morbidity is high after laparotomy because it is an invasive procedure in patients who have been weakened by prior PD. In our series, Case 1 developed sepsis, a fistula due to leakage from the pancreaticojejunostomy, wound infection, and an intra-abdominal abscess after laparotomy, while Case 2 developed intra-abdominal infection and Case 3 developed an intra-abdominal abscess after interventional radiology. Unlike Case 1, however, Cases 2 and 3 did not suffer from sepsis. Therefore, interventional radiology seems to be a less invasive (and effective) option for the management of delayed arterial hemorrhage after PD. However, interventional radiology may be associated with serious complications since occlusion of the hepatic artery can lead to cholangitis, liver abscess, and hepatic failure. In our series, Case 2 underwent occlusion of the common hepatic artery, but did not develop any of these complications. Utilization of covered stents may provide a solution to such problems and better establish the role of interventional radiology in the management of delayed arterial hemorrhage after PD.[15,16]

In conclusion, interventional radiology is a less invasive treatment method compared with laparotomy. When delayed arterial hemorrhage occurs after PD, interventional radiology may be considered as the first-line treatment in suitable patients.

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