

## Biliary Ischemia Following Embolization of a Pseudoaneurysm after Pancreaticoduodenectomy

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### ABSTRACT

**Aim** To report an uncommon consequence of hepatic artery occlusion in the management of a bleeding pseudoaneurysm following pancreaticoduodenectomy.

**Imaging** Analysis of a case involving a single patient in which a bleeding pseudoaneurysm of the gastroduodenal arterial stump following pancreaticoduodenectomy was treated by transcatheter arterial embolization.

**Case report** Effective hemostasis necessitated interruption of the hepatic arterial flow and was complicated by biliary ischemia and intrahepatic biloma.

**Conclusion** Transarterial embolization of the hepatic artery following pancreaticoduodenectomy can result in biliary ischemia and biloma formation.

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### INTRODUCTION

The occurrence of bleeding from a pseudoaneurysm after pancreaticoduodenectomy is a life-threatening condition with a mortality rate of up to 50% [1, 2]. Urgent laparotomy for primary repair of the bleeding artery is technically challenging, hazardous and does not eliminate the risk of rebleeding [3]. Transcatheter arterial embolization (TAE)

is now considered the optimal therapeutic treatment; it prevents the need for high-risk emergency surgery and enables definitive hemostasis in up to 87% of cases [3, 4].

A bleeding pseudoaneurysm sometimes requires the interruption of the hepatic arterial flow for effective control. Current complications of the interruption of the hepatic arterial flow are related to parenchymal ischemia and include liver infarction and liver abscess [4, 5].

We report the case of a bleeding pseudoaneurysm of the gastroduodenal arterial stump treated by TAE of the hepatic artery for definitive hemostasis which led to biliary ischemia and intrahepatic biloma formation.

### CASE REPORT

A 58-year-old male underwent a pancreaticoduodenectomy based on a diagnosis of ampullary carcinoma. He had a medical history of lymphoma which had been treated by radiotherapy and splenectomy 20 years prior to presentation. A high output pancreatic fistula occurred 7 days postoperatively and was managed by percutaneous drainage, antibiotics and total parenteral nutrition. Nineteen days postoperatively, following the appearance of blood in the abdominal drain and hematemesis, emergency abdominal angiography was performed. Bleeding from a

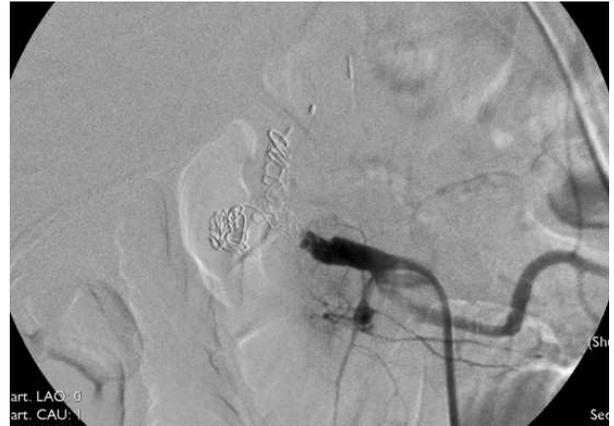


**Figure 1.** A 1.0 cm pseudoaneurysm of the gastroduodenal artery stump with extravasation.

1 cm pseudoaneurysm of the gastroduodenal artery stump was evident and selective embolization was performed into the pseudoaneurysm cavity using microcoils with effective initial hemostasis (Figures 1 and 2). Bleeding recurred 36 hours later, and angiography was urgently repeated showing a recurrence of the bleeding from the gastroduodenal arterial stump. A covered stent was not readily available; therefore, interruption of the hepatic artery by distal to proximal embolization of the extravasation site was necessary (Figure 3). The patient remained hemodynamically stable throughout this period during which resuscitation



**Figure 2.** Obliteration of the gastroduodenal artery stump pseudoaneurysm by coil embolization.



**Figure 3.** Complete obliteration of the hepatic artery by distal to proximal coil embolization of the extravasation site.

included five units of packed red blood cells. Liver function tests, including transaminase levels remained within the normal range for 6 days post-hepatic artery embolization. Fever and leukocytosis developed 10 days following the final occlusion of the hepatic artery. A contrast-enhanced abdominal computed tomography demonstrated a fluid collection without a rim enhancement within the left lobe of the liver treated by percutaneous drainage and corresponded to an intrahepatic biloma (Figure 4). The patient recovered and was discharged from the hospital 54 days postoperatively. Initially, the external biliary fistula drained 500 mL/day but resolved following 3 months of percutaneous drainage.



**Figure 4.** Contrast-enhanced abdominal CT demonstrating an intrahepatic biloma within the left lobe treated by percutaneous drainage.

## DISCUSSION

A bleeding pseudoaneurysm after pancreaticoduodenectomy originates from major vascular structures which have been exposed by regional lymphadenectomy or from the gastroduodenal arterial stump [3]. Gastroduodenal arterial stump bleeding remains a problem despite appropriate surgical techniques. An urgent laparotomy to control and repair the artery is rarely successful due to the extensive inflammation and necrosis posterior to the pancreatic anastomosis; it has a high mortality rate and does not eliminate the risk of rebleeding [6, 7]. Instead, selective angiography and TAE is now considered the standard therapeutic management; it enables the precise localization of a ruptured pseudoaneurysm and allows selective microcoil embolization [8]. TAE prevents the need for high-risk emergency surgery and provides definitive hemostasis in 63% to 87% of cases [3, 4]. Although, control of the bleeding can be achieved by selective microcoil embolization in the pseudoaneurysm cavity, rebleeding may occur, as in our case, and interruption of the hepatic arterial flow is most often warranted for effective hemostasis [4, 8]. Interruption of the hepatic arterial flow is usually well-tolerated and has been performed with impunity in some cases following pancreaticoduodenectomy [6, 8]. However, recent data from Yoon *et al.*, reveal a 30% incidence of liver abscess after hepatic artery occlusion for bleeding pseudoaneurysms after pancreaticoduodenectomy [4]. Kim *et al.* found that six out of seven patients who formed hepatic abscesses following hepatic artery embolization after having undergone a prior Whipple procedure [9]. The present case is unique in the development of biloma, presumably because of biliary ischemia rather than parenchymal ischemia as previously reported. The dependence of the biliary tree on the arterial supply is well-known and is emphasized by the experience of liver transplantation. In the instances when the graft survives, arterial thrombosis may be followed by biliary necrosis and biloma

formation [10, 11, 12]. During pancreaticoduodenectomy, collateral vessels in the hepatoduodenal ligament carrying the arterial input to the liver are widely transected. Interruption of the arterial flow in this setting is an anatomical condition similar (except for accessory diaphragmatic collaterals) to that of a liver graft complicated by arterial thrombosis and may explain the risk for biliary complications [13].

Bleeding pseudoaneurysm is among the most serious, life-threatening complications which can occur following pancreaticoduodenectomy; therefore, anticipation and treatment of such bleeding is a major concern for surgeons who perform pancreatic resections. When a soft pancreas without ductal dilatation (dangerous pancreatic remnant) is to be reconstructed, the surgeon must be prepared for an increased risk of an anastomotic leak and for subsequent, often lethal, hemorrhage. Anastomotic disruption leads to sepsis in the pancreatic bed where major vascular structures have been exposed by regional lymphadenectomy, creating a setting for pseudoaneurysm formation, arterial erosion or ligature slough [14, 15].

We also advocate trying to avoid vascular injuries during lymphadenectomy, meticulous anastomosis and wrapping the dissected vessels [4, 8]. Use of the preserved falciform ligament as a vascular pedicle to cover the gastroduodenal arterial stump has been described [16]. We anticipate the problems related to interrupting the hepatic arterial flow and recommend a complete dissection of the gastroduodenal artery so that the arterial stump is of at least 1 cm in length providing sufficient length to enable safe microcoil embolization in the rare event of catastrophic bleeding from the arterial stump. Alternatively, gastroduodenal artery-preserving pancreaticoduodenectomy can be considered for cases with a dangerous pancreatic remnant [15]. Postoperatively, the percutaneous placement of a covered stent into the hepatic artery can arrest pseudoaneurysmal bleeding while preserving common hepatic artery patency [17,18]. Many authors actually consider this therapeutic

option as the first-line treatment for a bleeding pseudoaneurysm in critical situations where the consequences of hepatic artery occlusion may be disastrous [19, 20].

In conclusion, the present case highlights the risk factors for gastroduodenal artery aneurysm and bleeding, and the first-line treatment involving micro-coil aneurysm embolization, potential second-line treatments including hepatic artery covered-stent placement and terminal hepatic artery embolization. Moreover, the potential consequences of these life-saving maneuvers are demonstrated, including the previously unreported complication of biliary ischemia and biloma formation.

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**Keywords** Aneurysm, False; Embolization, Therapeutic; Ischemia; Pancreaticoduodenectomy

**Abbreviations** TAE: transcatheter arterial embolization

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