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Transcatheter Arterial Embolization of the Common Hepatic Artery for Pseudoaneurysm after a Laparoscopic-Assisted Pancreaticoduodenectomy: A Case Report

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Laparoscopic pancreaticoduodenectomy; Pseudoaneurysm of common hepatic artery; DSA; Microcoil embolization; Postoperative complications

1. Abstract

Common hepatic artery (CHA) pseudoaneurysm is a rare and potentially life-threatening complication after pancreaticoduodenectomy, and the possible cause is unclear. We report a case of intraperitoneal hemorrhage after pancreaticoduodenectomy who was discharged after embolization under DSA. We consider that this complication may be related to iatrogenic injury.

2. Key Clinical Message

Intraperitoneal hemorrhage is one of the serious postoperative complications. We found the pseudoaneurysm of common hepatic artery after laparoscopic pancreaticoduodenectomy by DSA and used microcoil embolization for cure. We reviewed the procedure of laparoscopic surgery and identified several factors that might reduce postoperative bleeding.

3. Introduction

Pancreaticoduodenectomy (PD) is the main procedure for some surgeries related to the pancreas. Due to the advance of the surgical technology in recent two decades, mortality decreased considerably [1]. However, the morbidity rate for the major complication after PD remains high [2]. In the various complications, postpancreatectomy hemorrhage (PPH) is a fatal complication, which is linked with 11%−38% of the overall mortalities [3-6]. According to the International Study Group of Pancreatic Surgery [7], late PPH is caused by a ruptured pseudoaneurysm. Once the pseudoaneurysm ruptures, laparotomy and endovascular intervention are the main treatment to be done. Here, we report the clinical features, diagnosis, and treatment of a case of pseudoaneurysm formation due to massive hemorrhage in the common hepatic artery (CHA) after PD. Finally, we used the microcoils under DSA to block the common hepatic artery, to prevent further bleeding.

4. Case Report

A 48-year-old male patient underwent a modified Child PD for the malignant tumor of the descending duodenum. He had right upper quadrant pain for 3 months. The pain started 30 minutes after eating and relieved after defecation. There was no chills, fever, and diarrhea. Physical examination revealed a blood pressure=144/90mmHg, pulse=84beats/min, BMI=27.40. The whole abdomen was slightly distended, tender to palpation, no tenderness, no rebound tenderness, and no pulsatile abdominal mass. Digital rectal exam-

ination was negative. CA19-9 was 14.15U/ml, CEA was 2.38ng/ml. The gastroscope and abdominal enhanced computed tomography (CT) in the preoperative examinations are displayed in Figure 1. The related index and laboratory values of the patient showed no abnormal outcomes. Standard modified Child PD was performed after excluding the surgical contraindications. No adverse events occurred during the operation. Antibiotic prophylaxis was administered in the postoperative treatment. On postoperative day (POD) 2, the patient suffered from fever and abdominal pain. Persistent peritoneal lavage and drainage were conducted to prevent anastomotic leakage. On POD 8, the continuous drainage stopped because of disappearing abdominal pain. On POD 10, the patient had a sudden abdominal pain and showed 50 mL loss of blood from the drain of cholangiojejunostomy. Hemoglobin concentration decreased to 85 g/L, which had dropped by 45 g/L compared to the last inspection. At the same time, the amylase level measured in the intra-abdominal drainage fluid was 1480u/L. In terms of diagnosis, pancreatic fistula and intra-abdominal bleeding were considered. Conservative treatment, including fluid infusion, use of hemostatic agents, and blood transfusion, was used for this patient. Then, the patient's condition was stabilized gradually. Abdominal CT was performed on the POD 19, which revealed the existence of bloody fluid collection around the perihepatic area (Figure 2). On POD 21, the patient underwent catheter drainage under the guidance of ultrasonic from the perihepatic area. Abdominal distension of the patient improved. However, on POD 25, the patient abruptly developed melena and hematemesis, and vomited about 300 mL of bloody fluid. A total of 200 mL bright red bloody fluid drained from the abdominal tube. Then, the patient suffered from a shock with hypotension and tachycardia. Hence, Active abdominal bleeding was considered. Urgent Digital Subtraction Angiography (DSA) performed on the basis of a joint decision between the interventional radiologist and a surgeon. DSA revealed a pseudoaneurysm after the rupture of the CHA (Figure 3a, Video 1). Then, embolization of the hepatic artery with microcoil was performed successfully (Figure 3b, Video 2). The patient's blood pressure returned to normal after embolization. And then the patient regained hemodynamic stability and was transferred to the Intensive Care Unit (ICU). The patient was successfully discharged from the hospital on POD 38. Postoperative pathology showed moderately differentiated adenocarcinoma in the duodenal papilla, with a size of 2.5x2.0x1.6cm, invading the whole layer of the duodenal wall and nerves. The pancreatic margin, duodenal margin, gastric margin, and common bile duct margin were negative (cutting edge > 5mm). And no metastasis was found in the four lymph nodes. Postoperative pathological stage was pT3N0M0. The patient refused the genetic testing due to economic problems, so there was no diagnosis of MSI or MMR. Followed up for 3 to 6 months, there were no obvious recurrence or metastasis in abdominal CT.

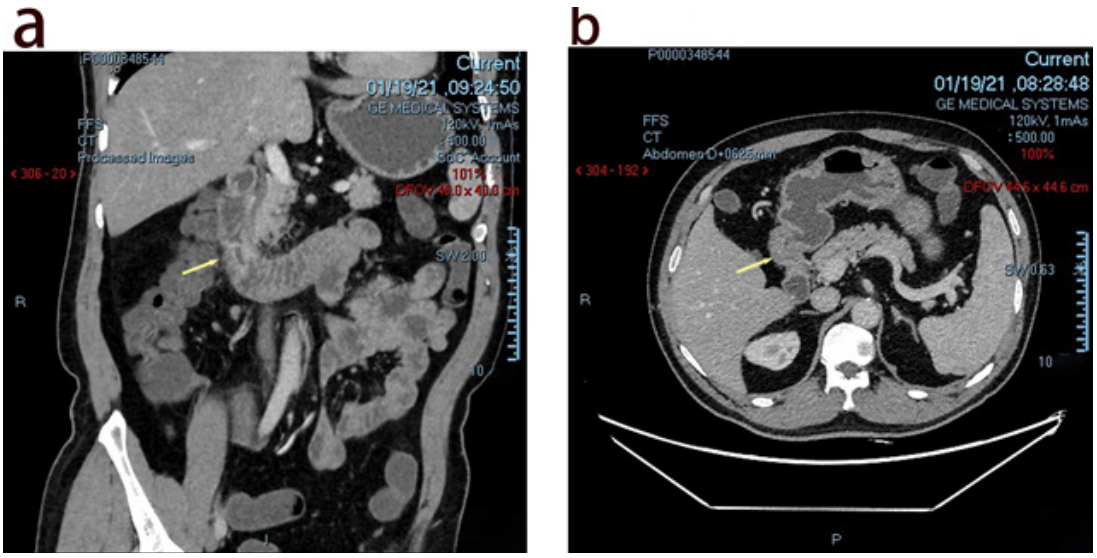


Figure 1: Plain abdominal CT scan revealed lesion of the descending duodenum (yellow arrow). a: Coronal plane view. b: Horizontal plane view.

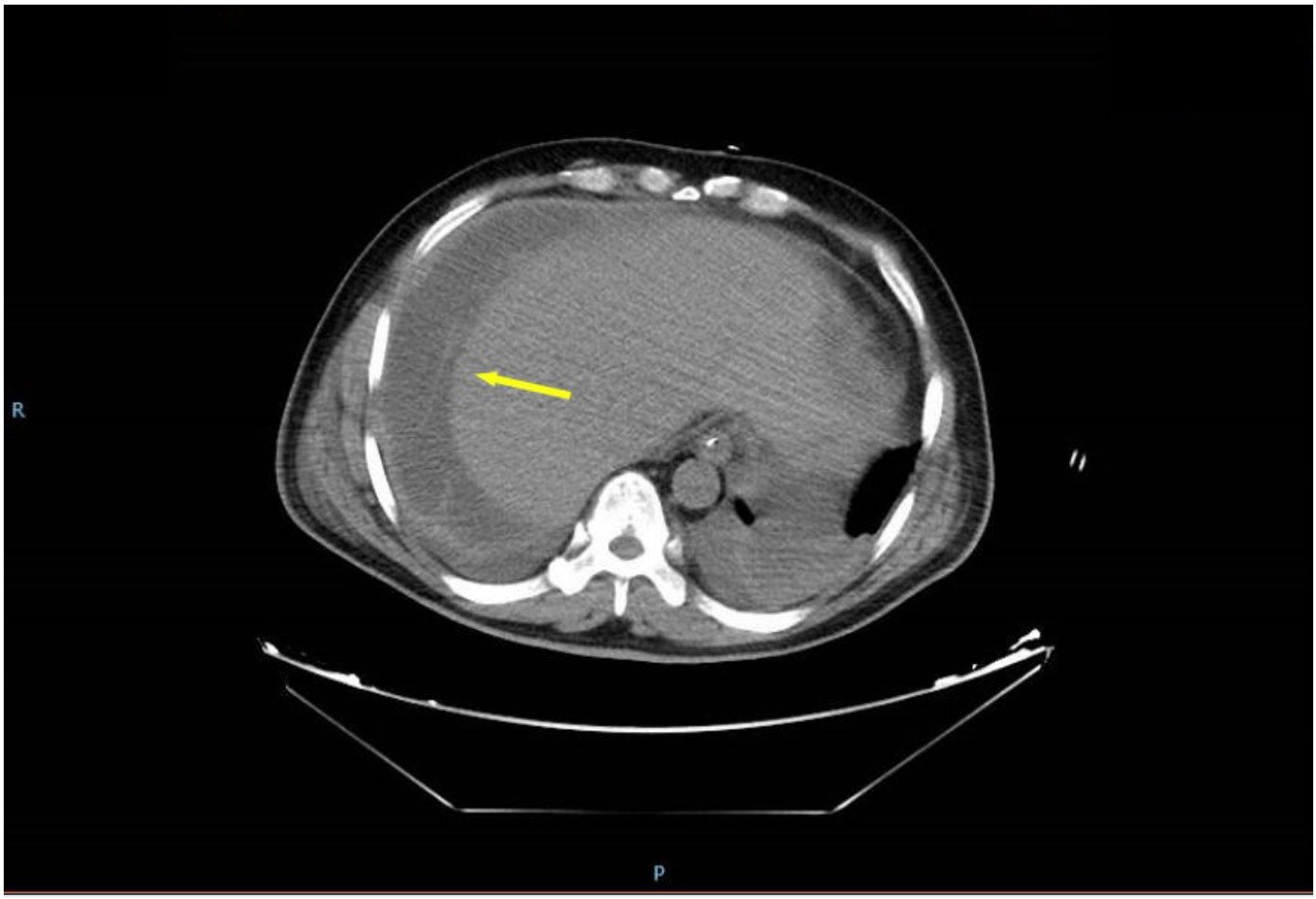


Figure 2: Emergency abdominal CT plain scan showed perihepatic effusion.

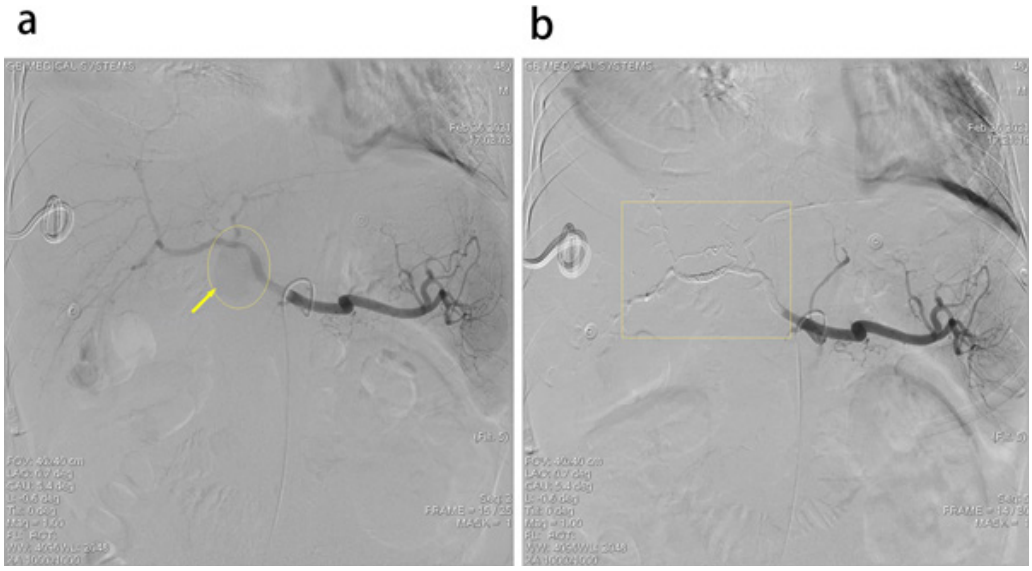


Figure 3: Urgent Digital Subtraction Angiography (DSA). a: pseudoaneurysm of CHA (yellow arrow). b: Successful embolization of hepatic artery with microcoil.

4.1. DSA Procedure

The patient lied supine on the DSA table; a puncture in the right femoral artery was performed after local anesthesia. The 5FRH catheter was placed into the right femoral artery, the catheter head was inserted into the celiac trunk artery for DSA, and the super-selected microcatheter (Terumo Progreat microcatheter, Japan) was inserted into the hepatic artery. After the hepatic artery, its branches were identified by contrast; the embolization microcoil was placed, followed by the injection of the histoacryl (B.Braun Closure Specialities, Germany) into the hepatic artery. Ultimately,

the hepatic artery and its branches did not develop again and hence were not visualized under DSA.

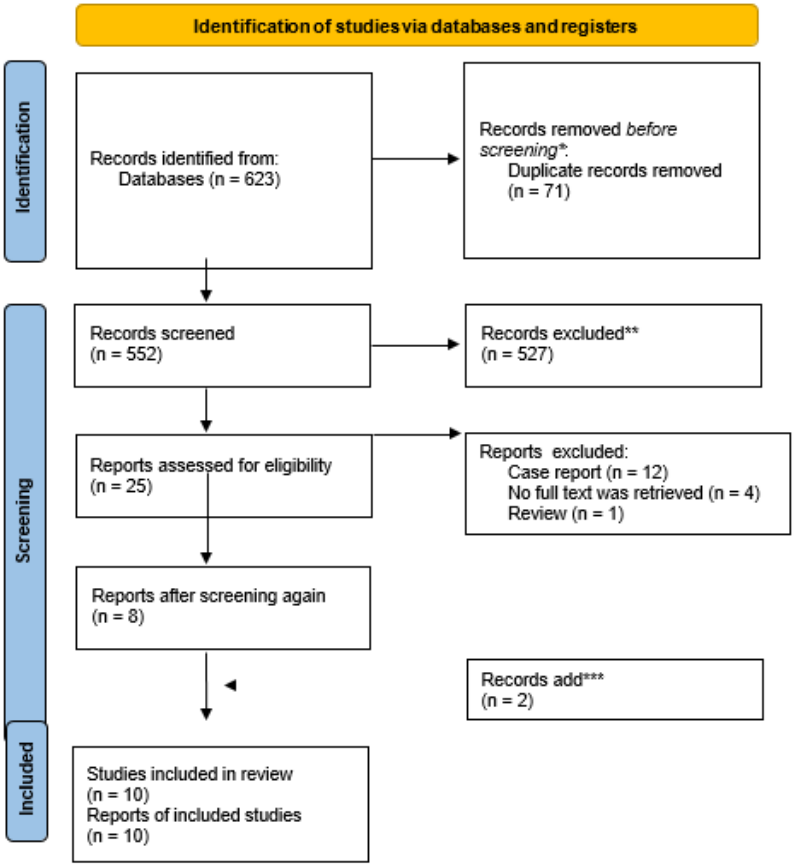
5. Discussion

Commonly, complications develop after PD; there is no doubt that PPH is dangerous and fatal. Furthermore, a ruptured pseudoaneurysm is the most severe and fatal cause of PPH [8]. The formation of the pseudoaneurysm is associated with the damage to the vascular wall. Although adequate lymph node dissection and skeletonization of the vessels in surgery may significantly improve the patient's prognosis, the dissection and skeletonization make the arterial wall weak and vulnerable, which is susceptible to erosion by trypsin and elastase from the digestive juice [9]. We made a systematic review of the literature over the 20 years. This descriptive systematic review formulated its research question based on PICO: P –, Participants, I – Intervention, C – Comparator, O – Outcomes. The inclusion criteria were P: Patients with pseudoaneurysm after pancreaticoduodenectomy (including laparoscopic assisted), I: Common hepatic artery embolization under DSA, C: Surgery, O: Stop bleeding. Type of article: Multicenter clinical trial, RCT, and Original article. The exclusion criteria were: i, Not all conditions are met (only one or more of the search conditions are met). ii, Full text not retrieved. iii, The type of article is case report or review. The search strategy was "(((embolization) AND (common hepatic artery)) AND (pseudoaneurysm)) AND (pancreaticoduodenectomy)". We systematically searched the following databases: PubMed, Coherane, Elsevier, Science Direct (SDOS), Springer Link, Online library Wiley, EBSCO and OvidEmbase. The initial literature search identified 623 articles and the remaining 25 after reweighting. No relevant text was retrieved from the bibliography. After screening and data extraction, 8 articles were eligible, we added 2 articles by searching citations, and 10 were finally included in this systematic review. Figure 4 is the flowchart of study selection. The information of all articles included is shown in Table 1. Unfortunately, we were unable to retrieve meaningful reports related to laparoscopic pancreatic surgery. From these 10 articles [17-26], A total of 389 postoperative patients has been included. Only 38.5% of patients with pseudoaneurysms occurred in CHA. The average time from postoperative to diagnosis of pseudoaneurysm was 18.05 ± 1.22 days. Coil embolization was used in about 50% of patients. Combining all articles, we found that the use of coil embolization and covered stent are the two most common treatment methods. However, it is still inconclusive which of the two methods is better or worse. Coil embolization is one of the most common treatment methods, which can effectively block the blood supply of pseudoaneurysm, but it is easy to lead to hepatic artery ischemia. However, the covered stent can take good care of the blood supply of the liver, but the cost is high, and it also needs technology and well anesthesia conditions [10]. Then, we analyzed the pathogenesis of this case, which may be related to laparoscopic instrument operation. Especially, the dissociation of vessels and dissection of the lymph nodes caused excessive skeletonization, and then the Hem-o-lock ligation damaged the arterial wall, which may lead to the formation of the pseudoaneurysm in the stump of the ligated artery. In this case, intraperitoneal hemorrhage occurred after surgery, and the measured drainage liquid amylase was 1480u/L; thus, it was considered that the digestive fluid leak caused by the pancreatic fistula, corroded the blood vessels, and eventually led to bleeding. After conservative treatment, there is a possibility of hemodynamic instability that would require emergency DSA examination; the formation of a pseudoaneurysm of the CHA and arterial embolism are also considered. Microcoil was chosen given the hemodynamic instability of the patient; while the liver has a double blood supply, a simple embolism is not likely to cause liver ischemia necrosis. Microcoil and histoacryl embolization were chosen given.

A recent meta-analysis revealed that endovascular treatment of a ruptured pseudoaneurysm had low mortality and morbidity and high success rate than surgical intervention [11,12]. Endovascular treatment is considered the first choice in the treatment of pseudoaneurysm recently. Endovascular treatment consists of Transcatheter Arterial Embolization (TAE) and stent-graft placement. Coil embolization as a TAE is an effective approach for the treatment of a pseudoaneurysm [13,14]. In this case, we summarized several experiences for the iatrogenic traumatic pseudoaneurysm. Based on these experiences, we give some possible suggestions on how to avoid and reduce this complication. First, excessive skeletonization of the blood vessels should be avoided, which leads to the injury of the endangium. In addition, when dealing with the stump of the gastroduodenal artery, the lymph node should be proper to avert excessive skeletonization. Second, compression, avulsion, clamping, or stretching of the skeletonization vessels in the laparoscopic operation increases the risk of bleeding and may cause injury of the endangium. Therefore, accurate vascular localization is the key to a successful operation, and improper operation should be avoided especially when ligating the arteries. Third, when using the Hem-o-lock to ligate the artery, it should be closed slowly, which avoids the shearing action to vessels in the closure process, and damage to the arterial stump. Finally, the vessels and lymph nodes should be skeletonized with laparoscopic instruments by blunt dissection. According to our experience, the skeletonization of the blood vessels tends to be covered with an omental flap to prevent hemorrhage after the PD. Several studies [15,16] revealed that the omental flap or falciform ligament placement over a skeletonization of blood vessels could be an effective measure for the prevention of pseudoaneurysm formation after PD. In conclusion, this case demonstrated the successful experience for the treatment of delayed PPH by TAE. Endovascular treatment is the first choice for the diagnosis and treatment of a ruptured pseudoaneurysm after PD. Although a stent-graft placement is considered a first-line treatment in the endovascular treatment, coil emboliza-

tion is a reliable, safe, and effective method particularly when unstable hemodynamics of the patient was observed. In a word, when making the treatment plan, the patient's condition, presentation, and clinical history should be taken into consideration.

PRISMA 2020 flow diagram for new systematic reviews which included searches of databases and registers only



Use the Find Duplicates function of software (endnote 20), except automatically.

**No automation tools used. Contains only 1 or not all search terms.

***We added 2 articles through Citation retrieval

Figure 4: PRISMA 2020 flow diagram.

Table 1: Basic information for all articles

Author	Year	Patients (n)	CHA[1] (n)	POD[2]	Consequence[3] (n)	Micro coil[4] (n)
Yoshitsugu T [17]	2007	4	3 (75.0%)	24.5	0	4(100%)
Lee HG[18]	2010	27	8 (29.6%)	18.3	2	8(29.6%)
Ding X[19]	2011	23	3 (13.0%)	17.7	11	20(87.0%)
Gwon DI[20]	2011	35	7 (0.2%)	15.7	1	3(8.6%)
Lee JH[21]	2012	27	8 (29.6%)	21	6	21(77.8%)
Cui L[22]	2020	17	16 (94.1%)	15.3	6	0
Hwang K[23]	2020	37	10 (27.0%)	21	0	16(43.2%)
Habib JR[24]	2022	130	18 (13.8%)	12	21	59(45.4%)
Tetsuya H[25]	2017	27	19(70.4%)	21	8	17(63.0%)
You, Y[26]	2019	62	20(32.3%)	14	5	30(48.4%)

1. The bleeding occurred in the common hepatic artery (CHA)
2. Days from postoperative to intervention
3. Number of patients who eventually died
4. Number of patients treated with micro coils

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