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TranscatheterArterial Embolization of the Common HepaticArtery for Pseudoaneurysm after a Laparoscopic-Assisted Pancreaticoduodenectomy: A Case Report

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Keywords:

Laparoscopicpancreaticoduodenectomy; Pseudoaneurysm of common hepatic artery; DSA; Microcoil embolization; Postoperative complications

1. Abstract

Common hepatic artery (CHA) pseudoaneurysm is a rare and potentiallylife-threateningcomplicationafterpancreaticoduodenectomy,andthepossiblecauseisunclear.Wereportacaseofintraperitoneal 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.Wefoundthepseudoaneurysmofcommonhepaticartery after laparoscopic pancreaticoduodenectomy by DSA and usedmicrocoilembolizationforcure.Wereviewedtheprocedure 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 surgicaltechnologyinrecenttwodecades,mortalitydecreasedconsiderably[1].However,themorbidityrateforthemajorcomplication 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 PPHiscausedbyarupturedpseudoaneurysm.Oncethepseudoaneurysmruptures,laparotomyandendovascularinterventionarethe 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 DSAto block the common hepatic artery, to prevent further bleeding.

4. Case Report

A48-year-oldmalepatientunderwentamodifiedChildPDforthe malignanttumorofthedescendingduodenum.Hehadrightupper quadrantpainfor3months.Thepainstarted30minutesaftereatingandrelievedafterdefecation.Therewasnochills,fever,anddiarrhea.Physicalexaminationrevealedabloodpressure=144/90mmHg, pulse=84beats/min, BMI=27.40. The whole abdomen was slightly distended, tender to palpation, no tenderness, no rebound tenderness,andnopulsatileabdominalmass.Digitalrectalexam-

ination was negative. CA19-9 was 14.15U/ml, CEAwas 2.38ng/ml.Thegastroscopeandabdominalenhancedcomputedtomography(CT)inthepreoperativeexaminationsaredisplayedinFigure 1.Therelatedindexandlaboratoryvaluesofthepatientshowedno abnormal outcomes. Standard modified Child PD was performed after excluding the surgical contraindications. No adverse events occurredduringtheoperation.Antibioticprophylaxiswasadministeredinthepostoperativetreatment.Onpostoperativeday(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 becauseofdisappearingabdominalpain.OnPOD10,thepatienthad a sudden abdominal pain and showed 50 mL loss of blood from thedrainofcholangiojejunostomy.Hemoglobinconcentrationdecreased to 85 g/L, which had dropped by 45 g/Lcompared to the last inspection. At the same time, the amylase level measured in theintra-abdominaldrainagefluidwas1480u/L.Intermsofdiagnosis, pancreatic fistula and intra-abdominal bleeding were considered. Conservative treatment, including fluid infusion, use of hemostaticagents,andbloodtransfusion,wasusedforthispatient. Then,thepatient'sconditionwasstabilizedgradually.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 guidanceofultrasonicfromtheperihepaticarea.Abdominaldistensionofthepatientimproved.However,onPOD25,thepatient abruptly developed melena and hematemesis, and vomited about 300mLofbloodyfluid.Atotalof200mLbrightredbloodyfluid drainedfromtheabdominaltube.Then,thepatientsufferedfroma shockwithhypotensionandtachycardia.Hence,Activeabdominal bleedingwasconsidered.UrgentDigitalSubtractionAngiography (DSA) performed on the basis of a joint decision between the interventionalradiologistandasurgeon.DSArevealedapseudoaneurysm after the rupture of the CHA(Figure 3a, Video 1). Then, embolization of the hepatic artery with microcoil was performed successfully(Figure3b,Video2).Thepatient'sbloodpressurereturnedtonormalafterembolization.Andthenthepatientregained 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,andcommonbileductmarginwerenegative(cuttingedge > 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.

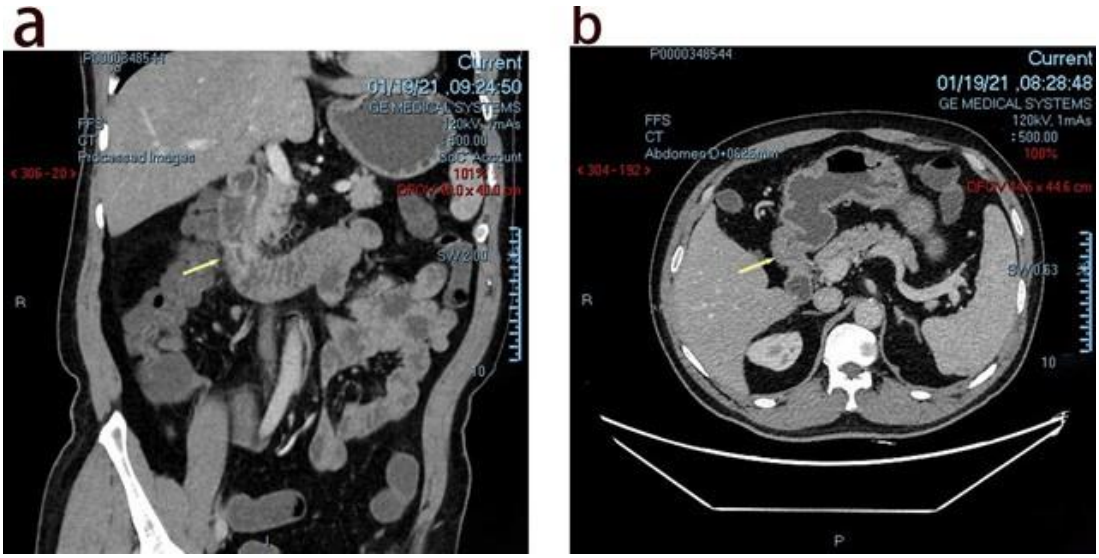


Figure1:PlainabdominalCTscanrevealedlesionofthedescendingduodenum(yellowarrow).a:Coronalplaneview.b:Horizontalplaneview.

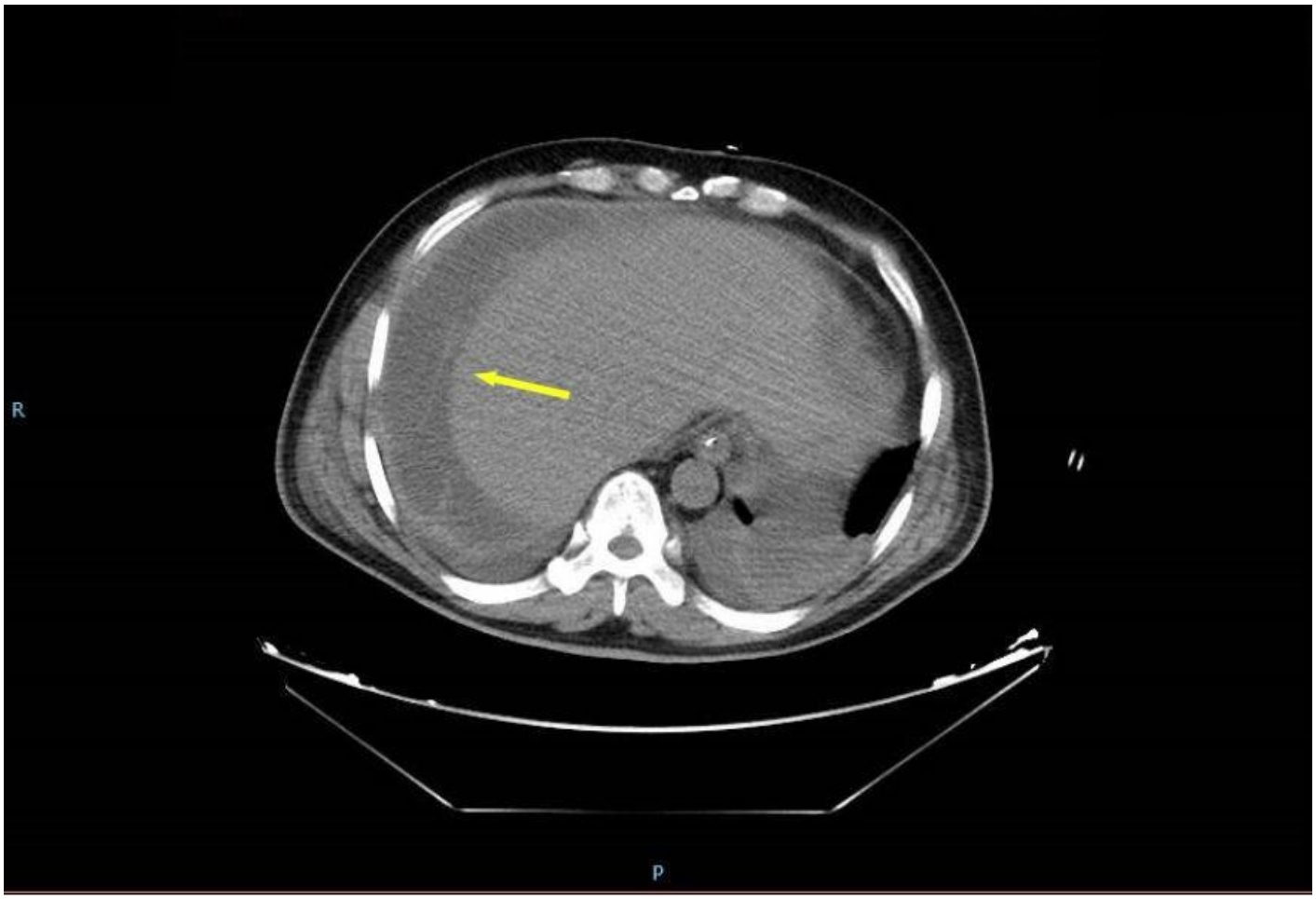


Figure2:EmergencyabdominalCTplainscanshowedperihepaticeffusion.

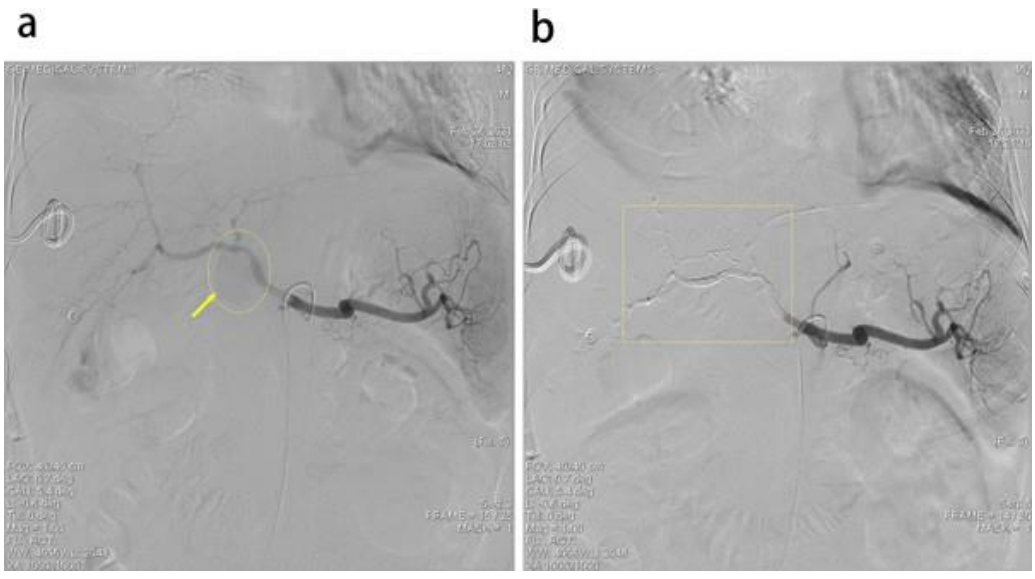


Figure 3: Urgent Digital SubtractionAngiography (DSA). a: pseudoaneurysm of CHA(yellow arrow). b: Successful embolization of hepatic artery with microcoil.

DSAProcedure

The patient lied supine on the DSAtable; a puncture in the right femoral artery was performed after local anesthesia. The 5FRH catheterwasplacedintotherightfemoralartery,thecatheterhead wasinsertedintotheceliactrunkarteryforDSA,andthesuper-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 ClosureSpecialities,Germany)intothehepaticartery.Ultimately,

thehepaticarteryanditsbranchesdidnotdevelopagainandhence were not visualized under DSA.

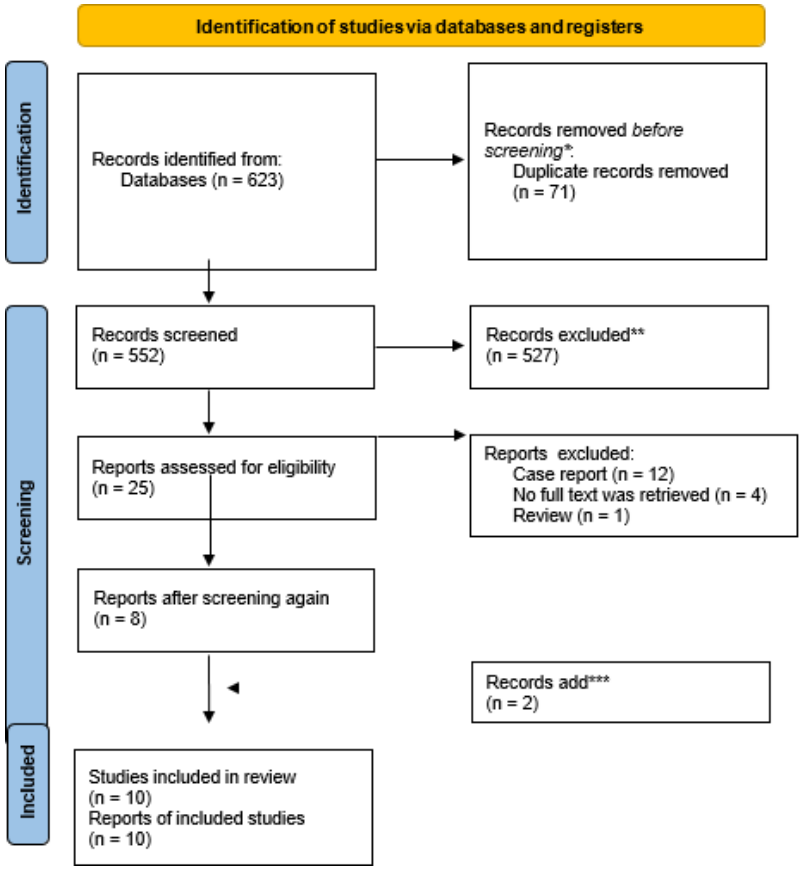
5. Discussion

Commonly,complicationsdevelopafterPD;thereisnodoubtthat PPHisdangerousandfatal.Furthermore,arupturedpseudoaneurysmisthemostsevereandfatalcauseofPPH[8].Theformation of the pseudoaneurysm is associated with the damage to the vas- cular 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 systematicreviewoftheliteratureoverthe20years.Thisdescrip- tive 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:Stopbleeding.Typeofarticle:Multicenterclinicaltri- al, 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 (commonhepaticartery))AND(pseudoaneurysm))AND(pancreaticoduodenectomy)". We systematically searched the following databases: PubMed, Coherane, Elsevier, Science Direct (SDOS), Springer Link, Online library Wiley, EBSCO and OvidEmbase. Theinitialliteraturesearchidentified623articlesandtheremain- ing 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 finallyincludedinthissystematicreview.Figure4istheflowchart ofstudyselection.Theinformationofallarticlesincludedisshown in Table 1. Unfortunately, we were unable to retrieve meaningful reports related to laparoscopic pancreatic surgery. From these 10 articles [17-26],Atotal of 389 postoperative patients has been included.Only38.5%ofpatientswithpseudoaneurysmsoccurredin CHA. The average time from postoperative to diagnosis of pseudoaneurysmwas18.05±1.22days.Coilembolizationwasusedin about 50% of patients. Combining all articles, we found that the use of coil embolization and covered stent are the two most commontreatmentmethods.However,itisstillinconclusivewhichof thetwomethodsisbetterorworse.Coilembolizationisoneofthe mostcommontreatmentmethods,whichcaneffectivelyblockthe blood supply of pseudoaneurysm, but it is easy to lead to hepatic arteryischemia.However,thecoveredstentcantakegoodcareof thebloodsupplyoftheliver,butthecostishigh,anditalsoneeds technologyand well anesthesia conditions[10].Then, we analyzed the pathogenesis of this case, which may be related to laparoscopicinstrumentoperation.Especially,thedissociationofvessels 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 stumpoftheligatedartery.Inthiscase,intraperitonealhemorrhage 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 isapossibilityofhemodynamicinstabilitythatwouldrequireemergency DSA examination; the formation of a pseudoaneurysm of theCHAandarterialembolismarealsoconsidered.Microcoilwas chosengiventhehemodynamicinstabilityofthepatient;whilethe liverhasadoublebloodsupply,asimpleembolismisnotlikelyto cause liver ischemia necrosis. Microcoil and histoacryl emboliza- tion were chosen given.

Arecent meta-analysis revealed that endovascular treatment of a ruptured pseudoaneurysm had low mortality and morbidity and highsuccessratethansurgicalintervention[11,12].Endovascular treatment is considered the first choice in the treatment of pseudoaneurysm recently. Endovascular treatment consists of TranscatheterArterial Embolization (TAE) and stent-graft placement. Coil embolization as aTAE is an effective approach for the treatment of a pseudoaneurysm [13,14]. In this case, we summarized several experiences for the iatrogenic traumatic pseudoaneurysm. Basedontheseexperiences,wegivesomepossiblesuggestionson how to avoid and reduce this complication. First, excessive skeletonization of the blood vessels should be avoided, which leadsto the injury of the endangium. In addition, when dealing withthestumpofthegastroduodenalartery,thelymphnodeshouldbe 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 causeinjuryoftheendangium.Therefore,accuratevascularlocalization is the key to a successful operation, and improper operationshouldbeavoidedespeciallywhenligatingthearteries.Third, whenusingtheHem-o-locktoligatetheartery,itshouldbeclosed slowly, which avoids the shearing action to vessels in the closure process,anddamagetothearterialstump.Finally,thevesselsand lymphnodesshouldbeskeletonizedwithlaparoscopicinstruments bybluntdissection.Accordingtoourexperience,theskeletonizationofthe bloodvesselstendstobe coveredwithanomentalflap to prevent hemorrhage after the PD. Several studies [15,16] revealedthattheomentalflaporfalciformligamentplacementover a skeletonization of blood vessels could be an effective measure forthepreventionofpseudoaneurysmformationafterPD.Inconclusion, this case demonstrated the successful experience for the treatment of delayed PPH by TAE. Endovascular treatment is the firstchoiceforthediagnosisandtreatmentofarupturedpseudoaneurysmafterPD.Althoughastent-graftplacementisconsidereda firstlinetreatmentintheendovasculartreatment,coilemboliza-

tionisareliable,safe,andeffectivemethodparticularlywhenunstablehemodynamicsofthepatientwasobserved.Inaword,when making the treatment plan, the patient's condition, presentation, and clinical history should be taken into consideration.

PRISMA2020flowdiagramfornewsystematicreviewswhichincludedsearchesofdatabasesandregistersonly



UsetheFindDuplicatesfunctionofsoftware(endnote20),exceptautomatically.

**Noautomationtoolsused.Containsonly1ornotallsearchterms.

***Weadded2articlesthroughCitationretrieval

Figure4:PRISMA2020flowdiagram.

Table1: Basicinformationforall articles

Author	Year	Patients(n)	CHA[1](n)	POD[2]	Consequence[3](n)	Microcoil[4](n)
YoshitsuguT [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%)
TetsuyaH[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. Daysfrompostoperativeto intervention
3. Numberofpatientswhoeventuallydied
4. Numberofpatientstreatedwithmicrocoils

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