Clinical Case Report

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A rare variation of celiac trunk and hepatic artery complicating pancreaticoduodenectomy

A case report and literature review

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Abstract

Rationale: Anatomical variations of the celiac trunk and the hepatic artery are of considerable importance in hepatopancreatobiliary surgery, liver transplants, and radiological abdominal interventions.

Patient concerns: Here, we report a 57-year-old man with 2 weeks of painless progressive jaundice. Preoperative imaging and cytology brush results suggested an ampullary tumor and common hepatic artery anomaly (CTA) was reported. The patient underwent pancreaticoduodenectomy (PD). Intraoperatively, the CHA and gastroduodenal artery (GDA) were abnormal. The CHA emerged from the superior mesenteric artery (SMA). Computer tomography angiography (CTA) was performed postoperatively; surprisingly, the left gastric artery (LGA) and splenic artery (SA) arising from the anterior wall of the abdominal aorta replaced the normal structure of the celiac trunk, and an accessory left hepatic artery (LHA) emerged from the LGA.

Diagnoses: The patient was diagnosed with cholangiocarcinoma and accompanying extremely rare variation of celiac trunk and hepatic artery.

Interventions and outcomes: The patient underwent PD and had an uneventful postoperative evolution. There was no recurrence of the tumor and with normal liver function during the 10-month follow-up.

Interventions: The patient underwent PD and had an uneventful postoperative evolution.

Outcomes: There was no recurrence of the tumor and with normal liver function during the 10-month follow-up.

Lessons: Surgeons must keep in mind that arterial variation may be present in the vascular structures intraoperatively, even if it was not revealed in preoperative imaging. The preoperative identification of arterial variation and its relationship with the tumor is necessary to avoid intraoperative vascular injury and complications after surgery.

Abbreviations: AA = abdominal aorta, CHA = common hepatic artery, CHD = common hepatic duct, CTA = computer tomography angiography, GDA = gastroduodenal artery, HMT = hepatomesenteric trunk, LGA = the left gastric artery, LHA = left hepatic artery, MRCP = magnetic resonance cholangiopancreatography, PD = pancreaticoduodenectomy, PHA= proper hepatic artery, PS = pancreatic stump, PV = portal vein, RHA = right hepatic artery, SA = the splenic artery, SMA = superior mesenteric artery.

Keywords: celiac trunk, hepatic artery, hepatomesenteric trunk, pancreaticoduodenectomy, variation

1. Introduction

Pancreaticoduodenectomy (PD) is the most effective treatment for an ampullary tumor, which is associated with high morbidity and mortality rates, even if the complex procedure is performed in tertiary centers.[1,2] Anatomical variations of the hepatic artery and celiac trunk put an individual at a high risk of injury to the arterial supply and, subsequently, to severe hepatic ischemia, liver abscesses, biliary fistula, or hemorrhage.[1] Therefore, the accurate identification of these arterial variations would enhance the probability of successful surgery and decrease the rate of complications after the complex PD procedure. We describe a rare anomalous origin of the common hepatic artery (CHA) from the hepatomesenteric trunk (HMT). Moreover, the left gastric artery (LGA) and splenic artery (SA) arising from the anterior wall of the abdominal aorta and an accessory left hepatic artery (LHA) from the LGA supplying the left liver made this case extraordinary.

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2. Case presentation

The study was approved by the Ethical Committee of the First Affiliated Hospital, College of Medicine, Zhejiang University, and written informed consent was obtained.

A 57-year-old man was admitted to our department with a chief complaint of painless progressive jaundice for 2 weeks. The patient was a lifelong nonsmoker who did not consume alcohol and had no history of inherited diseases. There was no significant history of biliary or liver disease. Physical examination was

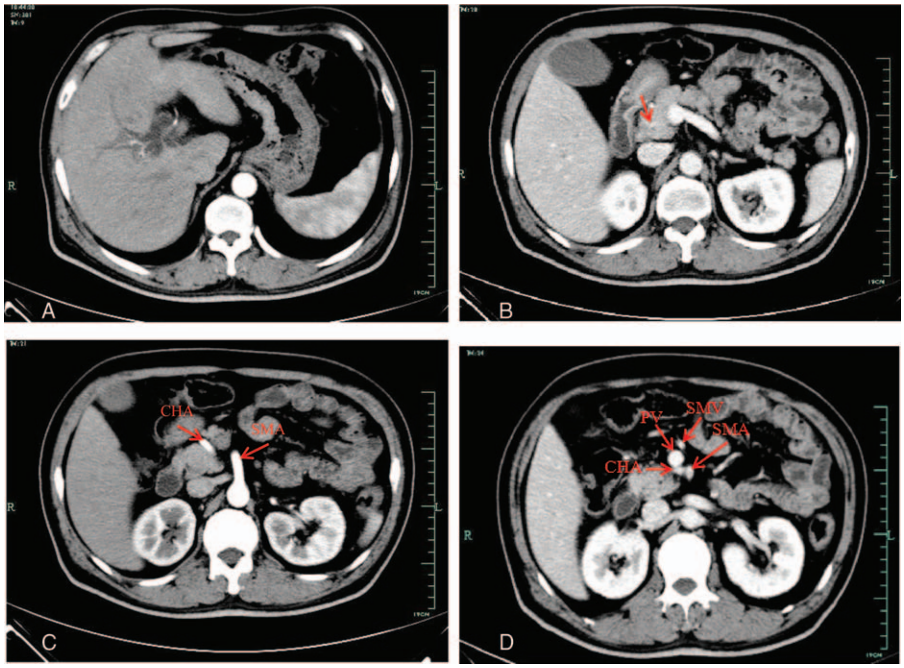

Figure 1. Contrast-enhanced computed tomography. (A) Dilation of intrahepatic and extrahepatic bile duct. (B) The distal common bile duct was slightly enhanced in portal venous phase (arrow). (C) In arterial phase: the common hepatic artery originated from the superior mesenteric artery and cross between the pancreas head and the uncinate process. (D) In portal phase, CHA running posterior to the portal vein. CHA = common hepatic artery, PV = portal vein, SMA = superior mesenteric artery, SMV = superior mesenteric vein.

unremarkable apart from icterus, and a Murphy sign test was negative. Hemogram, electrolytes, and amylase were within the normal limits. Liver function tests revealed the following: albumin 37.5 g/L, alanine aminotransferase 45 U/L, aspartate transaminase 30 U/L, gamma-glutamyltranspeptidase 1517 U/L, total bilirubin 201 μmol/L, and direct bilirubin 143 μmol/L. The following tumor markers were normal: carcinoembryonic antigen (11.2 ng/mL), alpha-fetoprotein carbohydrate antigen (CA) 19–9, and CA125. An abdominal computed tomography showed dilation of the intrahepatic and extrahepatic bile duct with obstruction at the level of the distal common bile duct, and the bile duct wall was slightly enhanced. An anomalous origin of the CHA was also revealed (Fig. 1). Magnetic resonance cholangiopancreatography (MRCP) demonstrated a rat tail shaped stricture of the distal common bile duct, and biliary tract malignancy was considered (Fig. 2). Endoscopic retrograde cholangiopancreatography revealed irregular stenosis of the pancreatic biliary duct and brush cytology was performed; a heterocyst was confirmed.

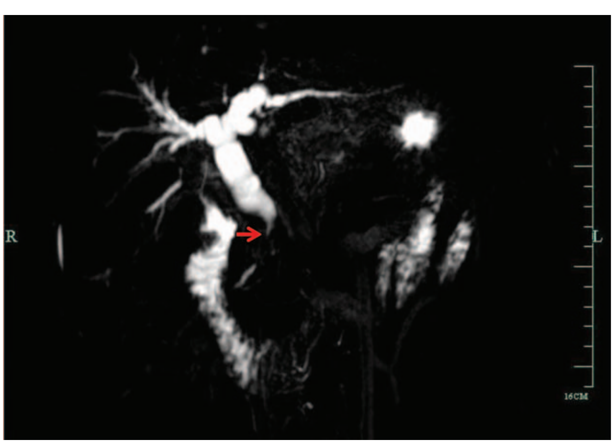

Figure 2. MRCP demonstrates rat-tail shaped stricture of the distal common bile duct (arrow). MRCP = magnetic resonance cholangiopancreatography.

The diagnosis of ampullary tumor was suggested based on imaging findings and cytology results. PD was performed not only to release biliary obstruction but also to cure the disease. Intraoperatively, a rare variation of the hepatic artery was observed after kocherization and hilar dissection. The CHA and gastroduodenal artery (GDA) were abnormal, with the CHA arising from the superior mesenteric artery (SMA) and crossing between the pancreas head and the uncinate process, giving off a few pancreatic branches and then dividing into the right gastric artery and GDA before giving off the proper hepatic artery at the upper margin of the pancreas. The pancreas was transected at the neck anterior to the portal vein (PV) and the CHA was preserved (Fig. 3). Ultimately, PD was successfully performed and a definitive diagnosis of cholangiocarcinoma was made. Computer tomography angiography (CTA) was performed on postoperative day 10. The complexity of the variant artery was beyond what was found during the operation (Fig. 4). The classical celiac trunk was absent, with the LGA and SA arising from the anterior wall of the abdominal aorta and an accessory LHA arising from the LGA. The CHA arose from the SMA and the common origin was termed the "hepatomesenteric trunk" (HMT). Although local stenosis of the proper hepatic artery was observed postoperatively (due to the successful solving the problem of obstructive jaundice as well as the accessory LHA and an intact portal blood supply), liver function gradually improved (Table 1). Fortunately, the postoperative course was favorable and the patient was discharged on postoperative day 14. There was no recurrence of the tumor and with normal liver function during the 10-month follow-up.

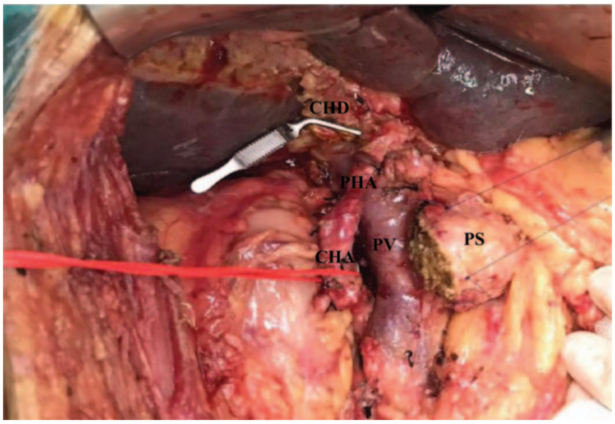

Figure 3. View of operating field after the neck of pancreas was transected. CHA = common hepatic artery, CHD = common hepatic duct, PHA = proper hepatic artery, PS = pancreatic stump, PV = portal vein.

3. Discussion

The classical trifurcation of the celiac trunk into the common hepatic, left gastric, and splenic arteries was first reported by Haller[3] in 1756 at a frequency of 72% to 90% in the normal population,[3–6] while normal hepatic arterial anatomy is reported in 52% to 80% of operative cases.[7,8] Information on variations in the celiac trunk and hepatic artery are important in open and laparoscopic hepatopancreatobiliary surgeries, liver transplants, and radiological abdominal interventions.[9,10]

In this case, trifurcation of the celiac trunk was absent, with the CHA and SMA originating from a common trunk termed the "hepatomesenteric trunk," and the LGA and SA originating directly from the anterior wall of the abdominal aorta. This variation of "no celiac trunk" was classified as Type VIII according to Uflacker classification[11] (Table 2). Celiac trunk bifurcation as a common anatomical variation has been reported at a rate of approximately 8% to 12% in the literature[6]; gastrosplenic trunk (Type V) and hepatosplenic trunk (Type II) were the most prevalent variation. However, the average rate of an absent celiac trunk was only 0.4% in the study by Bergman et al.[4] In addition, the rare variation termed "splenomesenteric trunk" has not described in any classification and has also been reported.[6,12]

The types of hepatic artery variation have been detailed described in Michel's classification[8] and other studies,[7,13,14] as well as anatomical monographs.[15] Nowadays, Michel's classification (Table 3) is still the most commonly used in clinic, as it established the difference between "replaced" and "accessory " hepatic artery, which was critical for hepatopancreatobiliary surgeries and liver transplants. There are 10 variant subtypes of the hepatic arterial system in Michel's classification and the replaced right hepatic artery from the SMA (Type III) and the replaced LHA from the LGA (Type II) are regarded as the most common types of hepatic arterial variation.[16–18] Moreover, López-Andújar et al[19] reported 2 new types not included in Michel's classification (Fig. 5). In the case described herein, the CHA originated from the SMA (Type IX) and accompanied an accessory LHA originating from the LGA (Type V). The anatomical variations of the hepatic artery (Type IX + Type V) that occurred in this patient are extremely rare. To the best of our knowledge, the unclassified variation of the hepatic artery accompanying an absence of the celiac trunk has been very rarely reported previously.

Aberrant arterial anatomy increases the surgical complexity and potential risk of injury to the arterial supply that could lead to ischemia, biliary fistula, bleeding, and liver abscess.[20,21] Although we were careful to perform an intraoperative dissection

Table 1

The changes of liver function in the perioperative period.

	Preoperative	POD1	POD4	POD10	POD14
ALT, U/L	45	25	13	16	16
AST, U/L	30	36	18	25	22
Alb, g/L	37.5	31.6	26.8	26.9	32.1
GGT, U/L	1517	327	159	128	72
TB, μmol/L	201	87	68	37	26
DB, μmol/L	143	63	49	22	16

ALT = alanine aminotransferase, AST = aspartate transaminase, Alb = albumin, TB = total bilirubin, DB = direct bilirubin, GGT = γ-glutamyl transpeptidase, POD = postoperative day.

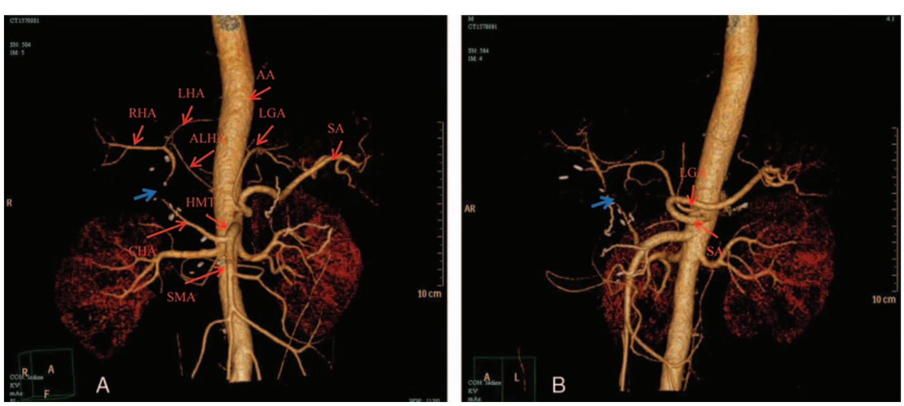

Figure 4. Computer tomography angiography postoperative. (A) The CHA and SMA arising from the HMT (Michels, type IX) and part of the proper hepatic artery is not clear, local stenosis is founded (blue arrow). In addition, an accessory LHA arising from LGA (Michels, type V) supplied part of the left hepatic blood flow. (B) In this view, LGA and SA arising from the anterior wall of the abdominal aorta respectively (red arrow) could be shown clearly. AA = abdominal aorta, ALHA = accessory left hepatic artery, CHA = common hepatic artery, HMT = hepatomesenteric trunk, LGA = left gastric artery, LHA = left hepatic artery, RHA = right hepatic artery, SA = splenic artery, SMA = superior mesenteric artery.

Table 2

Celiac trunk variations according to Uflacker classification[11].

Celiac trunk variation	Uflacker clasification
Classic celiac trunk	Type I
Hepatosplenic trunk	Type II
Hepatogastric trunk	Type III
Hepatosplenicmesenteric trunk	Type IV
Gastrosplenic trunk	Type V
Celiac-mesenteric trunk	Type VI
Celiac-colic trunk	Type VII
No celiac trunk	Type VIII

as far as possible and the CHA was preserved, the local stricture of the proper hepatic artery was still observed in the postoperative imaging. However, mainly due to the successful solving the problem of obstructive jaundice through the operation as well as the accessory LHA and an intact portal blood supply, liver function gradually improved and the patient recovered and was discharged. Therefore, clear recognition of these arterial variations both preoperatively and intraoperatively enhances the probability of a successful operation and limits harmful outcomes of complex hepatopancreatobiliary surgical procedures such as PD. Digital subtraction angiography was previously regarded as the gold standard in the evaluation of vascular structures but has now been replaced by CTA[22] and gadolinium-enhanced magnetic resonance angiography,[23,24] which could not only visualization of normal anatomy as well as anatomical variants, but also reduces the associated morbidity of angiography and the risk of introgenic injuries in complex surgical procedures, especially in hepatopancreatobiliary surgeries and liver transplants.[25] However, Yang et al[26] suggested that aberrant hepatic artery could be usually well demonstrated with routine MDCT once radiologists and surgeons paid more attention to the arterial variants, but had limitation in evaluating celiac trunk artery. Similarly, preoperative CT scan have also found hepatic artery variation in the present study, but we did not aware of the specific variation of celiac trunk until the CTA examination postoperative and also surprised to find an accessory LHA originating from the LGA.

4. Conclusion

The current study reports a case of PD with extremely rare celiac trunk and hepatic artery variation for cholangiocarcinoma. As a whole, the preoperative identification of arterial variation and its relationship with the tumor is necessary to avoid intraoperative vascular injury and complications after surgery.

Table 3

Hepatic artery variations: Michel classification.

Description	Type
Normal anatomy	I
Replaced left hepatic artery arising from left gastric artery	II
Replaced right hepatic artery arising from superior mesenteric artery	III
Coexistence of Type II and Type III	IV
Accessory left hepatic artery arising from left gastric artery	V
Accessory right hepatic artery arising from superior mesenteric artery	VI
Coexistence of Type V and Type VI	VII
Replaced right hepatic artery and accessory left hepatic artery or replaced left hepatic artery and accessory right hepatic artery	VIII
Common hepatic artery arising from SMA	IX
Common hepatic artery arising from the left gastric artery	X

SMA = superior mesenteric artery.

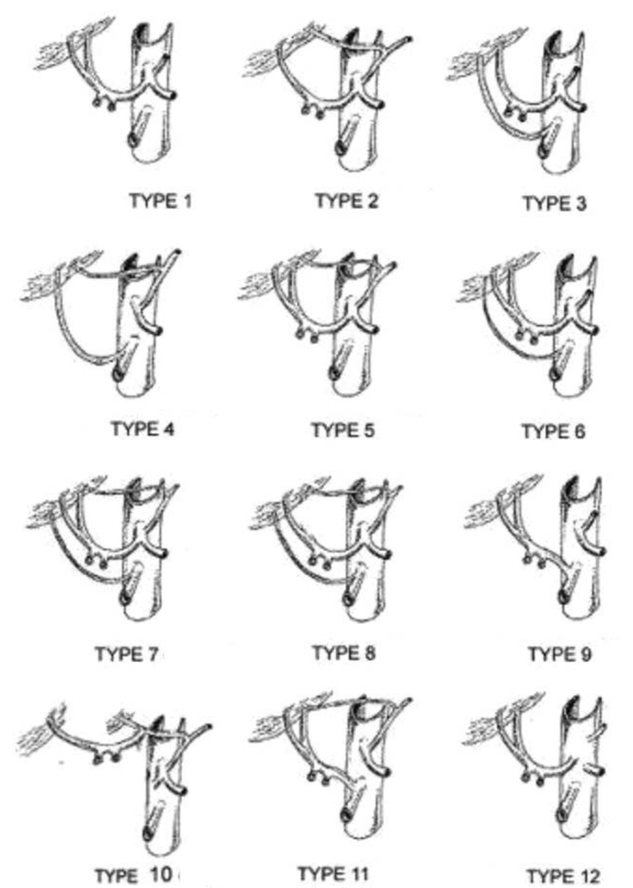

Figure 5. Ten variant subtypes of the hepatic arterial variations according to Michel's classification and 2 new types (type 11,12) not included in this classification.[19]

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