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Case Report

Proper Hepatic Artery from Superior Mesenteric Artery and Gastroduodenal Artery from Celiac Trunk: A Case Report of Rare Arterial Anatomy

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Abstract:

Background: Variations in hepatic arterial anatomy are well documented; however, the concurrent presence of a proper hepatic artery (PHA) originating from the superior mesenteric artery (SMA) and a gastroduodenal artery (GDA) arising directly from the celiac trunk (CeT) is extremely rare and remains largely unclassified in current anatomical literature.

Case Presentation: We report the case of a 56-year-old male presenting with obstructive jaundice, diagnosed with a periampullary carcinoma. Preoperative contrast-enhanced computed tomography revealed an absent common hepatic artery (CHA), with the PHA originating from the SMA and the GDA from the CeT. Notably, there was no communication between these vessels. Pancreaticoduodenectomy was successfully performed with careful vascular dissection and GDA test clamping, ensuring adequate hepatic perfusion. Postoperative recovery was uneventful. Histopathology confirmed a moderately differentiated adenocarcinoma staged pT2N0.

Conclusion: This case represents a highly unusual arterial configuration, with potential implications for surgical planning and intraoperative safety during hepatopancreatobiliary procedures. Preoperative imaging played a pivotal role in identifying this rare variation, enabling safe surgical management. Only three similar cases have been reported, highlighting the importance of recognizing and documenting such variants.

Key words: hepatic artery variation; proper hepatic artery; superior mesenteric artery; gastroduodenal artery; celiac trunk; pancreaticoduodenectomy; aberrant vascular anatomy

Introduction

Common hepatic artery (CHA) is defined as an arterial trunk containing at least one segmental hepatic artery and the gastroduodenal artery (GDA) irrespective of its origin and course.[1] Variations of the hepatic artery are common and thorough knowledge of possible variations in branching, courses, and distribution of the vessels supplying the liver, gallbladder, and gastroduodenal region is essential. To know the anatomy, including abnormal development of the hepatic artery is crucial before doing any major HPB surgeries. Normally after taking origin from the abdominal aorta, celiac trunk (CeT) divides into 3 branches: the left gastric artery (LGA), splenic artery (SA), and common hepatic artery (CHA). Further, CHA gives gastroduodenal artery (GDA) and becomes proper hepatic artery (PHA). PHA is the main source of blood supply to the liver and gallbladder. [2] In literature, there are many variations of hepatic artery reported, among which the most common variation was the Michels Type III in which replaced right hepatic artery (rRHA) originates from superior mesenteric artery (SMA) and accounts for 6-15.5%.[3] Arterial variation with the PHA originating from the SMA and GDA originating from the CeT are extremely rare and no mention of true incidence in the literature. This variation is close to Michels type IX variant, in which the entire CHA trunk originates from SMA and further gives GDA and becomes PHA which accounts for 2-2.5%. To our knowledge, these arterial variations have only been observed in 3 cases, among these 2 cases were discovered during cadaveric dissection and 1 during pancreaticoduodenectomy. [4-

5]. We report an extremely rare case in which the origin of the PHA from SMA and the origin of the GDA from CT. Which we identified by preoperative imaging, and pancreaticoduodenectomy (PD) was then successfully performed in a case of periampullary carcinoma.

Case Report:

A 56-year-old man presented with jaundice and generalised weakness of 2 months duration. Ultrasound abdomen shows bilobar dilated intrahepatic radicals, dilated common bile duct (CBD) and main pancreatic duct (MPD), and distended Gall bladder. Laboratory data showed direct hyperbilirubinemia, normal liver enzymes, and raised alkaline phosphatase. Contrast-enhanced computed tomography (CECT) showed a 2x1 cm periampullary lesion with upstream dilatation of both CBD and MPD. Ampullary biopsy shows moderately differentiated adenocarcinoma and we performed pancreaticoduodenectomy and lymphadenectomy. In preoperative CECT (Figure.1)

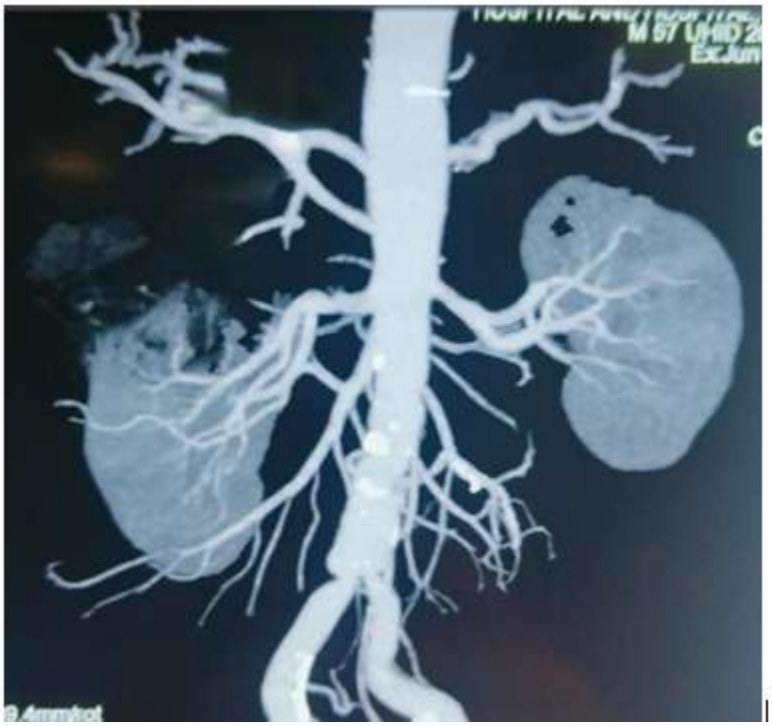

Figure 1: CT angiography showing Replaced PHA from SMA and GDA from Celiac trunk

CHA was absent and PHA originating from SMA and GDA originated from CeT. The GDA branched into the right gastroepiploic artery (RGEA) and superior pancreaticoduodenal artery (SPDA), and there is no communicating branch between the PHA and GDA. Left gastric artery (LGA) and Splenic artery (SA) originate from CeT normally and CHA was absent. The PHA course between the common bile duct and portal vein branched into the right and left hepatic arteries. (Figure.2)

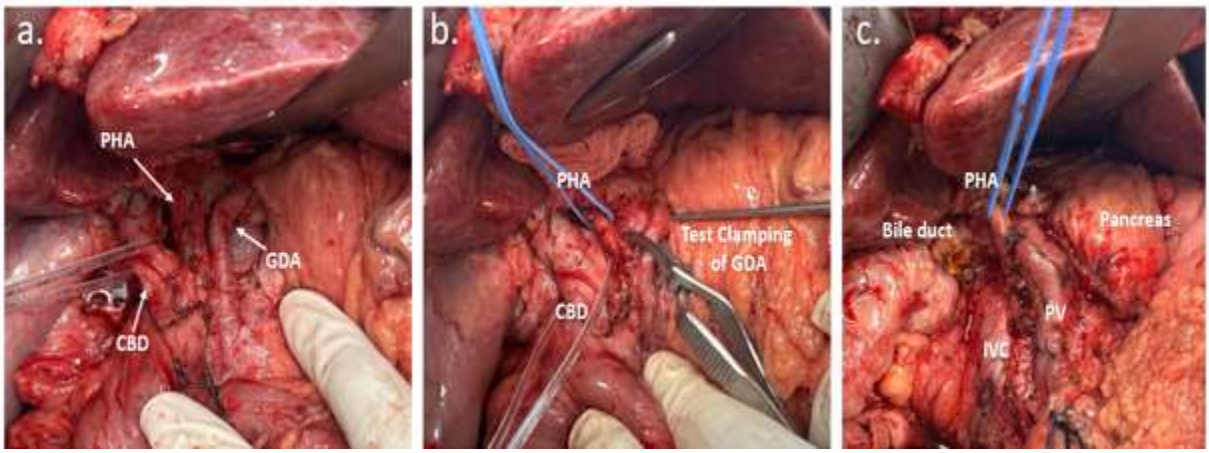

Figure 2: Intraoperative pictures (a)GDA originate from Celiac trunk and PHA from SMA (b)After dissection, no communicating vessel between PAH and GDA and GDA test clamping done (c)Post pancreaticoduodenectomy resection

Intraoperative findings and preoperative CECT pictures were matched. The GDA branched into the RGEA and SPDA, without any communication to PHA. PHA is traced from its origin (SMA) till it divided into RHA and LHA. GDA ligated after test clamping and the procedure was completed. The operative time was 430 minutes, and the blood loss was 300ml. (Fig.3)

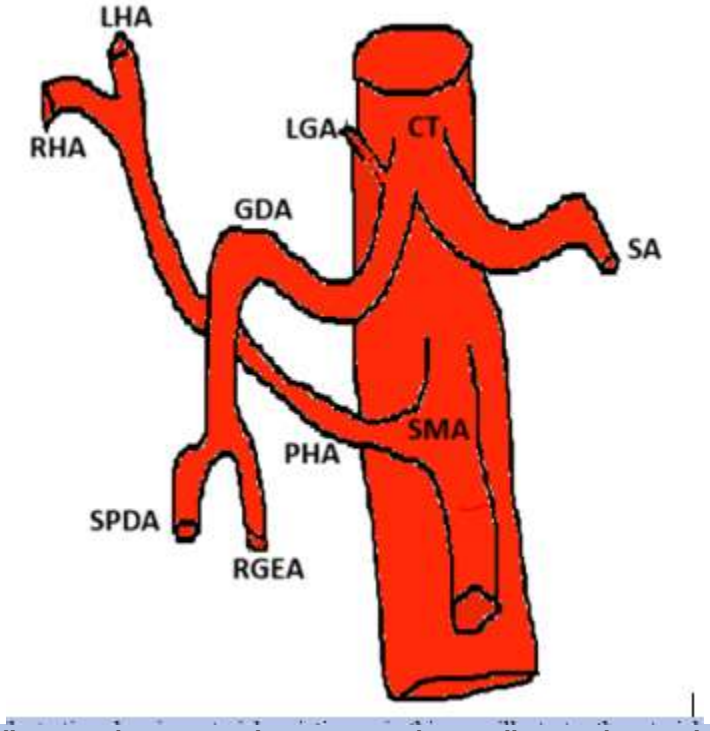

Figure 3: Schematic illustration showing arterial variation as in this case illustrates the arterial variations in this case.

The patient's postoperative course was uneventful. Histopathological report revealed moderately differentiated adenocarcinoma with stage of pT2N0.

Discussion:

Haller first described celiac axis variations in 1756. Michel described the classification for anatomic variation in the hepatic arterial blood supply based on the results of dissecting 200 cadavers in 1955.[3] After that many classifications for HA variations were proposed. Normally during embryologic development, four ventral vessels (LGA, SA, CHA, and SMA) stem from the abdominal aorta and these splanchnic arteries are paired vessels that are interconnected by longitudinal anastomoses. Normally longitudinal anastomosis between the SA and SMA roots is interrupted, leading to anatomic separation of the CeT from the SMA. Any changes in this process lead to several variations in the CeT and SMA. [6]

Very few reports have found PHA from SMA, and GDA to be a branch of the CeT, as was seen in this case. Michels classified anatomic variations of hepatic arteries into 10 types. Frequency of the entire hepatic trunk being derived from the SMA (type IX) was 2.5%, However, in this variation, GDA also originates from hepatic artery. Huang et al. described 6 variations in the absence of the CHA; however, the kind in which the PHA originates from the SMA, and GDA from CeT as seen in this case, remains unclassified.[7]

Covey et al. described the classification of anatomic variations of HA based on the results of digital subtraction angiography (DSA) performed in 600 patients. The variation wherein the PHA originated from the SMA and the GDA originated as a separate branch of the aorta was found in 2 patients (0.3%) [8]. Song et al. described the classification of celiac trunk (CeT) and CHA variations based on the results of spiral CT and DSA performed in 5002 patients. They defined the type of GDA originating

separately without any hepatic arterial component as the absence of CHA (1.10%).[1]

There were only 3 case reports with the same arterial variants as seen in this case; out of these 2 cases were discovered during cadaveric dissection, and one case report in which this variant was diagnosed by preoperative diagnostic imaging and pancreaticoduodenectomy was done.[5] Ours is the second report in which these arterial variants were diagnosed by preoperative diagnostic imaging, and pancreaticoduodenectomy was successfully performed.

In HPB surgery such as Pancreaticoduodenectomy, an in-depth knowledge of HA anomalies is of great importance to surgeons, and can help avoid iatrogenic injuries and postoperative complications. We did careful dissection and test clamping of GDA and looked for any communication with PHA.After confirming this GDA was ligated. Advancements in imaging such as multidetector CT technology have facilitated preoperative imaging evaluation of the hepatic vasculature [9]. Which facilitates diagnosing the rare arterial variants preoperatively, and helps in performing safe surgery.

Conclusion:

We report an extremely rare case of an aberrant PHA (originating from the SMA) and an aberrant GDA (originating from the CeT) that were diagnosed by CECT preoperatively and did pancreaticoduodenectomy safely without any vascular compromise. In HPB surgery, understanding variations in the hepatic artery before planning for surgery is crucial to ensure optimum surgical outcomes.

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Ethical Board: Institutional Ethics Committee/MAMC/2025: F. No.17/IEC/MAMC/2025/07: Our institute doesn't require ethical clearance for case reports.

Informed consent: Informed consent was obtained from the patient and guardian* to publish the case report and accompanying images.

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