CASE REPORT

Celiac Trunk with a Replaced Right Hepatic Artery: A Rare Anatomical Variant

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Abstract

The gastrointestinal tract and its accessory organs are supplied by the three main ventral branches of the abdominal aorta; namely, the celiac trunk, superior mesenteric artery, and inferior mesenteric artery. Variations of these vessels are related to the embryological development of the different parts of the gut; foregut, midgut, and hindgut. We report a case of a replaced right hepatic artery originating from the celiac trunk. Such variations are clinically important for the success of radiological image interpretation and surgical procedures of the region.

Keywords: replaced hepatic artery, aberrant hepatic artery, celiac trunk embryology, Couinaud's classification, Michel's classification

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Introduction

The anatomy of the celiac trunk (CT) and the hepatic artery (HA) are important in radiological procedures and surgeries involving the liver, gall bladder, pancreas, spleen, stomach, and duodenum (1, 2). Anatomical variations of these arteries are often encountered during these procedures (3, 4). They should be taken into consideration when planning procedures and interventions (2).

Several classification systems have been developed since the first description of CT and its branches by Haller in 1756 (5, 6, 7, 8). These classifications describe the variations in CT and HA. With this background, we report a case of a replaced right hepatic artery (rRHA) arising from the CT in a Sri Lankan adult cadaver.

Case Report

During routine dissections at the Department of Anatomy, Faculty of Medicine, University of Peradeniya, a rare variant of rRHA was observed in a 73-year-old adult Sri Lankan female cadaver.

No surgical scars were observed on the abdomen before dissection and no evidence of intra-abdominal surgery was seen. The liver, extrahepatic biliary system, and intestines were normal in gross appearance. We observed that the CT was the first ventral branch arising from the abdominal aorta as usual. Immediately after its origin, it gives off the left gastric artery (LGA) and the rRHA which runs posterior to both the portal vein and the common hepatic duct. 54.23 mm distal to its origin, the rRHA was seen to divide into 3 branches: two enter the right lobe of the liver and one becomes the middle hepatic artery. After giving LGA and rRHA, the coeliac trunk had a short course of 5.94 mm then it gave off its terminal branches: the splenic artery (SA) and the common hepatic artery (CHA) (Figure 1).

The CHA then divides into the left hepatic artery (LHA) and gastroduodenal artery (GDA) 23.49 mm distal to its origin. GDA gives off its first branch, the cystic artery (CA), 4.7 mm from its origin, which runs anterior to the common hepatic duct. After a short course of 22.46 mm, GDA is divided into two main branches: the anterior superior pancreaticoduodenal artery and the right gastroepiploic artery. No other arterial variations were detected in the abdominal vasculature of this cadaver.

Discussion

The CT is the first anterior branch of the abdominal aorta arising at the level of the 12th thoracic vertebra. It has three typical terminal branches; LGA, CHA, and SA (1, 6, 9, 10) (Figure 2). This artery supplies the foregut and its accessory organs. The LGA is small and supplies the lower oesophagus and lesser curvature of the stomach. SA runs along the upper border of the pancreas and gives off pancreatic branches to the pancreas, left gastroepiploic artery, and multiple short gastric arteries to the stomach, finally supplying the spleen.

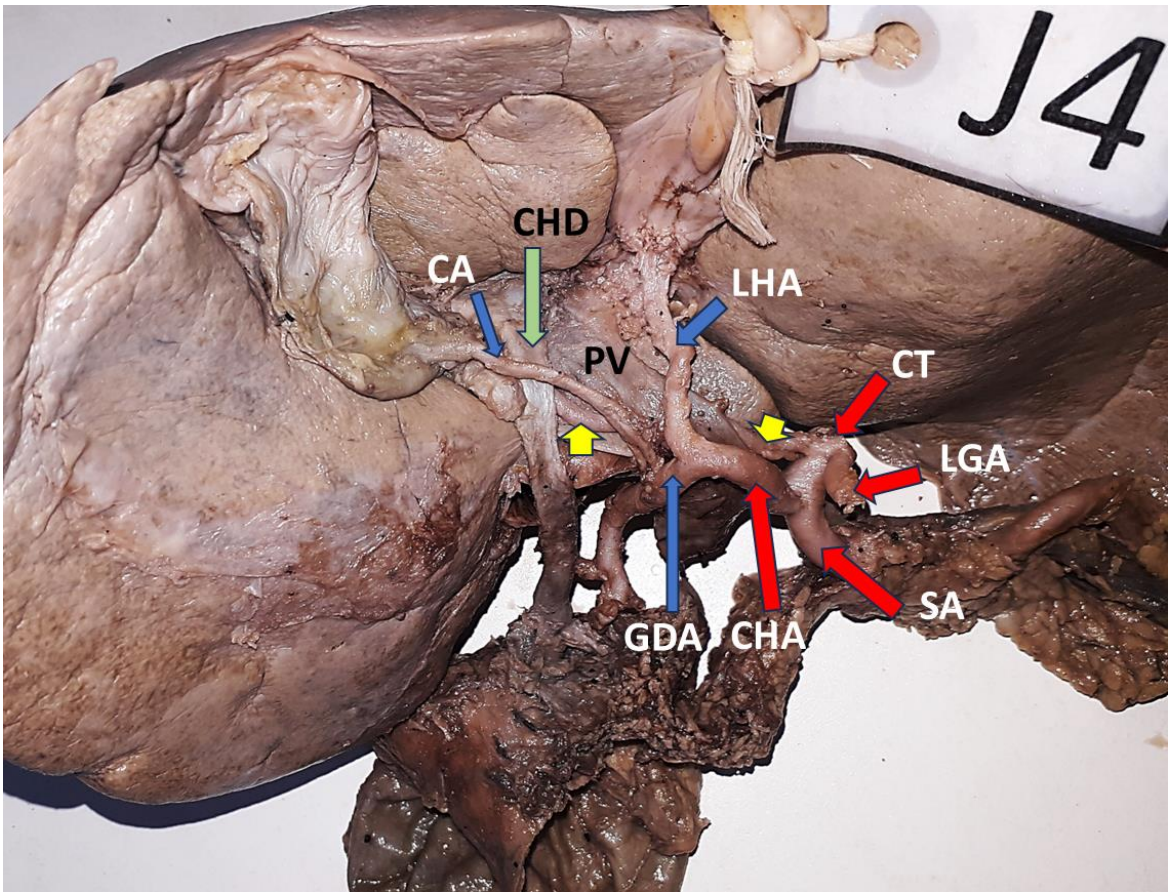

Figure 1: Replaced right hepatic artery from celiac trunk running posterior to the portal vein and common hepatic duct observed in the index case (CT – celiac trunk, LGA – left gastric artery, SA – splenic artery, CHA – common hepatic artery, GDA – gastroduodenal artery, LHA – left hepatic artery, CA – cystic artery, PV – portal vein, CHD – common hepatic duct, Structure highlighted in yellow arrows - replaced right hepatic artery)

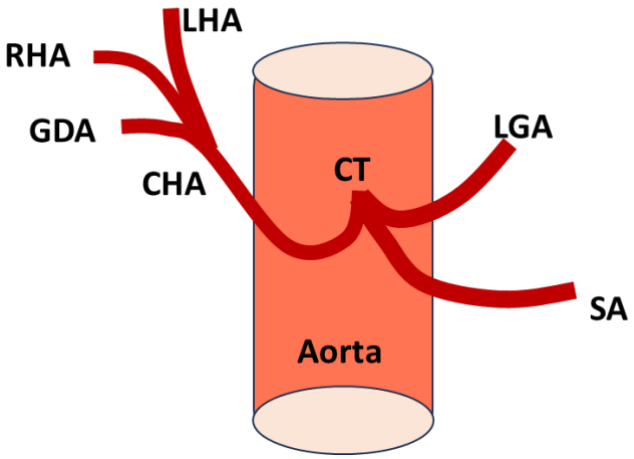

Figure 2: Typical pattern of celiac trunk branches (CT – celiac trunk, LGA – left gastric artery, SA – splenic artery, CHA – common hepatic artery, GDA – gastroduodenal artery, RHA – right hepatic artery, LHA – left hepatic artery)

The CHA gives off GDA to the stomach, common bile duct, pancreas, duodenum, and the right gastric artery to the stomach, becoming the proper hepatic artery. This divides into the right hepatic artery (RHA) and LHA at porta hepatis to enter the right and left lobes of the liver respectively. The CA that supplies the gall bladder usually comes from RHA (1, 10, 11).

Embryologically the CT is derived from vitelline arteries that arise between the yolk sac and the two dorsal aortae. Arterial plexuses form between these vitelline arteries on the ventral surface of the aortae and detach from the yolk sac by the end of 4th week of intrauterine life. During subsequent development, most of the anastomosing channels regress, and only three arterial segments will remain caudal to the diaphragm; namely the 10th, 13th, and 21st. These three arterial segments become the CT, superior mesenteric artery, and inferior mesenteric artery to supply the foregut and its derivatives, midgut and hindgut respectively. Any abnormality in regression or persistence in the ventral arterial anastomosis can lead to anatomical variations in these 3 main arteries and their branches (10, 11, 12, 13).

The typical pattern of CT being the trifurcation can be further divided into classic and non-classic patterns according to Couinaud's classification of CT anomalies (Table 1) (8). In the classic type, all three main branches have a common point of origin from CT. In the non-classic type, CHA and SA have a common origin and LGA will have a variable point of origin.

The CHA typically arises from the CT and ultimately gives off its branches to the liver, the RHA and the LHA. An aberrant/ anomalous origin of any of these hepatic arteries other than this is considered an aberrant HA. This can be of two types; accessory and replaced. An accessory HA is where an additional artery from another source supplies the liver lobe while the normal branch from celiac origin persists. This should be only used when there is a normal celiacal supply (5,11). A replaced HA is where the typical arterial branching pattern is absent, but a HA (either RHA or LHA) arising from aberrant/ anomalous origin supplies a liver lobe (3, 11). Michel's classification for hepatic artery variants is widely used and includes these aberrant arterial patterns (Table 2) (3, 5, 6).

According to Osman and Abdrabou, 70.5% of trifurcations are of classic pattern while the remaining 29.5% are of non-classic pattern which is the reverse in the findings of a review study done by Walker. He has mentioned the inferior phrenic artery arising from CT as the most common variant pattern (6, 11). According to the literature, the commonest pattern was Michel's type 1 while the most frequent anomaly in HA was Michel's type 3 (5, 6, 11). Our case is different as it couldn't be included in either Couinaud's classification or Michel's.

Behera et al. described a similar variant found during assessment for a pancreaticoduodenectomy procedure consisting of a rRHA from CT with an accessory LHA from LGA (3).

Table 1: Couinaud's classification of celiac trunk variation

Type	Description
Type I (Hepato-Gastro-Splenic trunk)	Trifurcation
Classic pattern	LGA, CHA, and SA have a common origin from the celiac trunk
Non-classic pattern	CHA and SA have a common origin, and LGA has a variable point of origin
Type II	Hepato-Splenic trunk, LGA separately from the aorta
Type III	Hepato-Gastric trunk, SA separately from aorta/ SMA
Type IV	Hepato-Spleno-Mesenteric trunk, LGA separately from the aorta
Type V	Gastro-Splenic trunk, CHA separately from the aorta
Type VI	Celiaco-Mesenteric trunk (CT and SMA have a common trunk)
Type VII	Celiaco-Colic trunk (CT and left colic/ middle colic have a common trunk)
Type VIII	Absent CT (LGA, CHA, SA directly from aorta)

In a cadaveric study done in Thailand, a similar four-branching CT was observed with three normal branches (CHA, LGA, SA) and a small accessory HA which entered the liver at the fissure for ligamentum venosum with no branches along its course (13). In another cadaveric case, the CT was absent and replaced with five arterial branches (LGA, SA, main HA, and two other hepatic branches) (9). Song et al. have described 13 types of CT variations including the normal pattern but didn't find the current variant described in this case report (14).

Table 2: Michel's classification of hepatic artery variation

Type	Description
Type I	HA from CHA, bifurcates into RHA and LHA
Type II	rLHA from LGA
Type III	rRHA from SMA
Type IV	rRHA, LHA from LGA
Type V	aLHA from LGA
Type VI	aRHA from SMA
Type VII	aRHA from SMA, aLHA from LGA
Type VIII	rRHA and aLHA or rLHA and aRHA
Type IX	CHA from SMA
Type X	CHA from LGA

CT – celiac trunk, CHA – common hepatic artery, HA – hepatic artery proper, RHA – right hepatic artery, LHA – left hepatic artery, LGA – left gastric artery, SA – splenic artery, SMA – superior mesenteric artery, rRHA – replaced RHA, rLHA – replaced LHA, aRHA – accessory RHA, aLHA – accessory LHA

Conclusion

We report a unique rRHA variant that will add to the existing knowledge base.

Arterial variations in the CT and HA are not rare and should be taken into consideration during abdominal procedures including radiology and surgery. Though they are usually asymptomatic, severe bleeding and other complications can occur if one is not vigilant.

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Ethical approval

Ethical approval was obtained from the Ethical Review Committee, Faculty of Medicine, University of Peradeniya (2022/EC/59).

Conflict of interest: None

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