Case Report

Rare variations in the Origin, Branching Pattern and Course of the Celiac Trunk: Report of Two Cases

Lokadolalu Chandracharya Prasanna, Rohini Alva, Guruprasad Kaltur Sneha, Kumar M R Bhat

Department of Anatomy, Kasturba Medical College, Manipal University, Manipal-576104, India

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Abstract

Multiple anomalies in the celiac arterial system presents as rare vascular malformations, depicting deviations of the normal vascular developmental pattern. We found a common left gastrophrenic trunk and a hepato-spleno-mesenteric trunk arising separately from the abdominal aorta in one cadaver. We also found a common hepatic artery and a gastro-splenic trunk arising individually from the abdominal aorta in another cadaver. Even though many variations in the celiac trunk have been described earlier, the complex variations described here are not mentioned and classified by earlier literature. Knowledge of such variations has significance in the surgical and invasive arterial radiological procedures in the upper abdomen.

Keywords: *celiac artery, superior mesenteric artery, variations, common hepatic artery*

Introduction

In general, vascular anomalies of the upper abdominal aorta are asymptomatic but become important in patients undergoing invasive radiological procedures like diagnostic angiography for gastrointestinal bleeding, celiac axis compression syndrome, liver transplantation, or prior to an operative procedures on upper abdominal viscera (1).

The celiac trunk (CT) is the major source of nourishment to the organs of the supracolic abdominal compartment. Heller's description of celiac trunk trifurcation (left gastric, splenic, and common hepatic arteries) is still considered as the normal branching pattern of the CT (2). Classical trifurcation pattern of celiac trunk is seen in about 87.6% cadavers and remaining 12.4% of the cases were with variations (3). Reported variations in the branching pattern of the celiac trunk includes: bifurcation of the trunk, absence of the trunk, presence of collateral vessels, and anomalous branches (3–6).

Though isolated cases of the celiac trunk were described in the literature, the combination of variations that we have described in this manuscript has not been reported. Here, we attempt to classify the branching pattern and discuss about the developmental correlations of the variations observed in our case, with a note on its potential clinical implications.

Case Report

During routine dissection for educational purposes, we found rare variations in the origin, branching pattern, and the course of the celiac trunk in two middle aged male cadavers. The dissection of the abdomen was carried out meticulously to analyse the origin, course and the supply of ventral branches of the abdominal aorta. The following variations in the celiac arterial system were observed:

Case 1

Close to the aortic opening, in place of the celiac trunk and its three major branches (left gastric, common hepatic, and splenic arteries), two branches arose separately from the abdominal aorta. One short branch can be named as gastrosplenic trunk, which originated from the ventrolateral part of the abdominal aorta close to the aortic opening. This trunk further divided into a small branch running towards the cardiac end of esophagus and gave few esophageal branches before it continued as left gastric artery along the lesser curvature of the stomach. Another larger branch from the same trunk, splenic artery, was running tortuously along the upper margin of the pancreas towards the spleen with its normal branches to pancreas and spleen as well as short gastric arteries to the fundus of the stomach.

In the same cadaver, just inferior and to the left of the gastrosplenic trunk, common hepatic artery springs from the right lateral aspect of the abdominal aorta as a separate branch. After the origin it immediately ascended behind the first part of duodenum to reach the right free margin of the lesser omentum. Two centimeters close to the porta hepatis, it gave off a larger gastroduodenal artery which was running downward in the right free margin of lesser omentum to reach the duodenum and head of the pancreas. After passing behind the first part of the duodenum, gastroduodenal artery divided into right gastroepiploic, and superior pancreaticoduodenal arteries with their normal course and branching pattern. Just before entering the porta hepatis, the hepatic artery now considered as the proper hepatic artery divided into its usual branches as right and left hepatic artery. Closer to this division, the proper hepatic artery gave rise to right gastric artery which descended within the lesser omentum to reach the lesser curvature of the stomach (Figure 1).

Case 2

In another cadaver, close to the aortic opening and in place of the origin of the celiac trunk, abdominal aorta gave a common gastro-phrenic trunk. Later, the trunk divided immediately into left phrenic and left gastric arteries and followed their normal course to reach the diaphragm and lesser curvature of the stomach respectively. Immediately below the origin of the gastro-phrenic trunk, a large mesenteric-hepato-splenic trunk was arising from the abdominal aorta which then descended for about 2.5 cm to enter the root of the mesentery. Just before its entry into the mesentery, this mesenteric-hepato-splenic trunk gave off a common trunk as hepatosplenic artery which then divided into common hepatic and splenic arteries. These branches followed their normal course and branching pattern. Thereafter, the superior mesenteric artery followed the normal course and branching pattern (Figure 2).

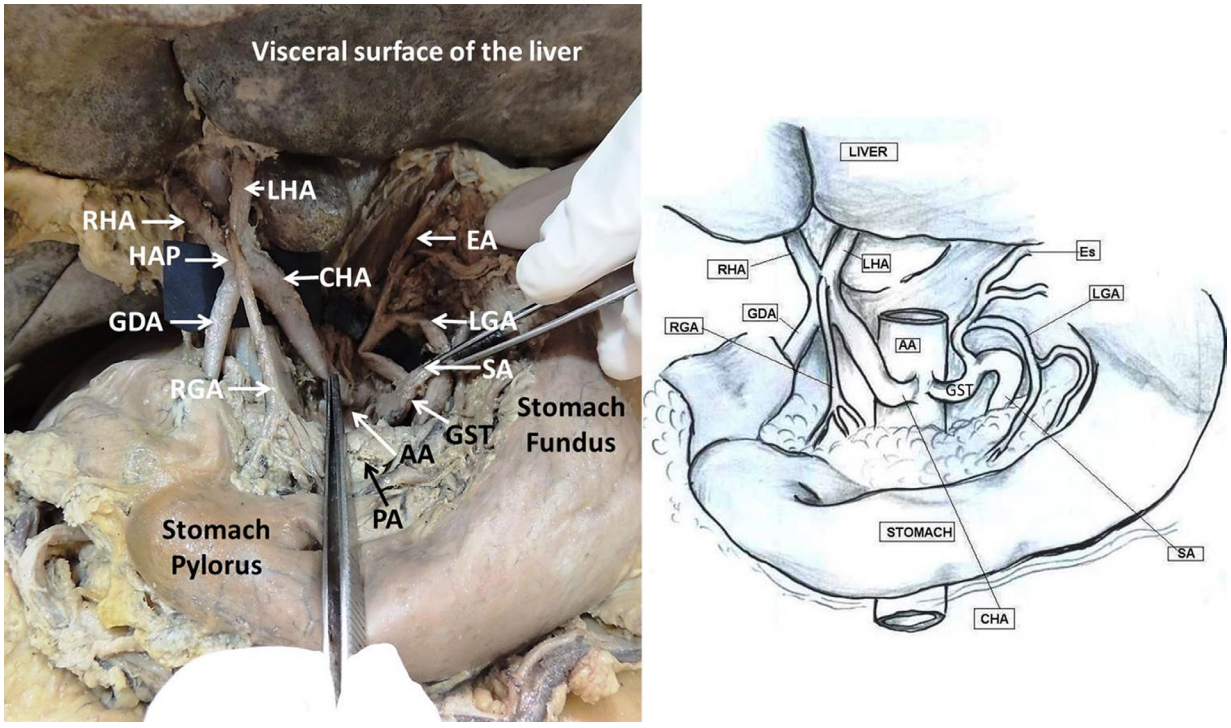

Figure 1: Case 1– Abdominal arota (AA) gave two branches – common hepatic artery (CHA) and Gastrosplenic trunk (GST). CHA, within the right free margin of the lesser omentum gave rise to gastrodeuodenal artery (GDA) and then right gastric artery (RGA) and continued as hepatic artery proper (HPA). Just before the porta hepatis, the HPA then divided into right and left hepatic arteries (RHA & LHA). The GST further gave rise to left gastric artery (LGA) and splenic arteries (SA). Abbreviations: EA= esophageal artery; PA = pancreas.

Discussion

Celiac trunk, the first ventral branch of the abdominal aorta begins as a short trunk at about 1.25 cm below the aortic opening of the diaphragm. After a short ventral course, the trunk divides into its three branches (left gastric, common hepatic and splenic arteries) to supply the foregut derivatives (7). As described by Michel, the variations of the celiac trunk are always associated with the variation in origin of the common hepatic artery (CHA). He reported that, the term replaced or aberrant common hepatic artery should be used cautiously only if the CHA is not a branch of the celiac trunk (8). Reported incidence of common hepatic artery originating from the superior mesenteric artery is 2 to 2.5% and from the abdominal aorta is from 0.2%to 10% (9). However, the origin of the CHA from the abdominal aorta is not mentioned in the classification made by the Michels (10). Further, the incidence of other types of origin of CHA which are not mentioned by Michels or Hiatt ranges from 0v-14.7% of all reported cases (1). However, the origin of the common trunk for both hepatic and splenic artery from superior mesenteric artery as seen by us in the second such case and has not been classified by earlier authors.

Normally, in all cases of abnormal origin of CHA, cystic artery begins close to the gall bladder in a twisted manner, which is more likely to get damaged in laparoscopic cholecystectomy. The ligation or embolization of hepatic arteries in the treatment of liver trauma, tumor and transplantation requires extensive knowledge of hepatic vascular pattern (11). This type of additional hepatic arteries must be carefully identified and taken care to avoid undue post-operative complication in upper abdominal

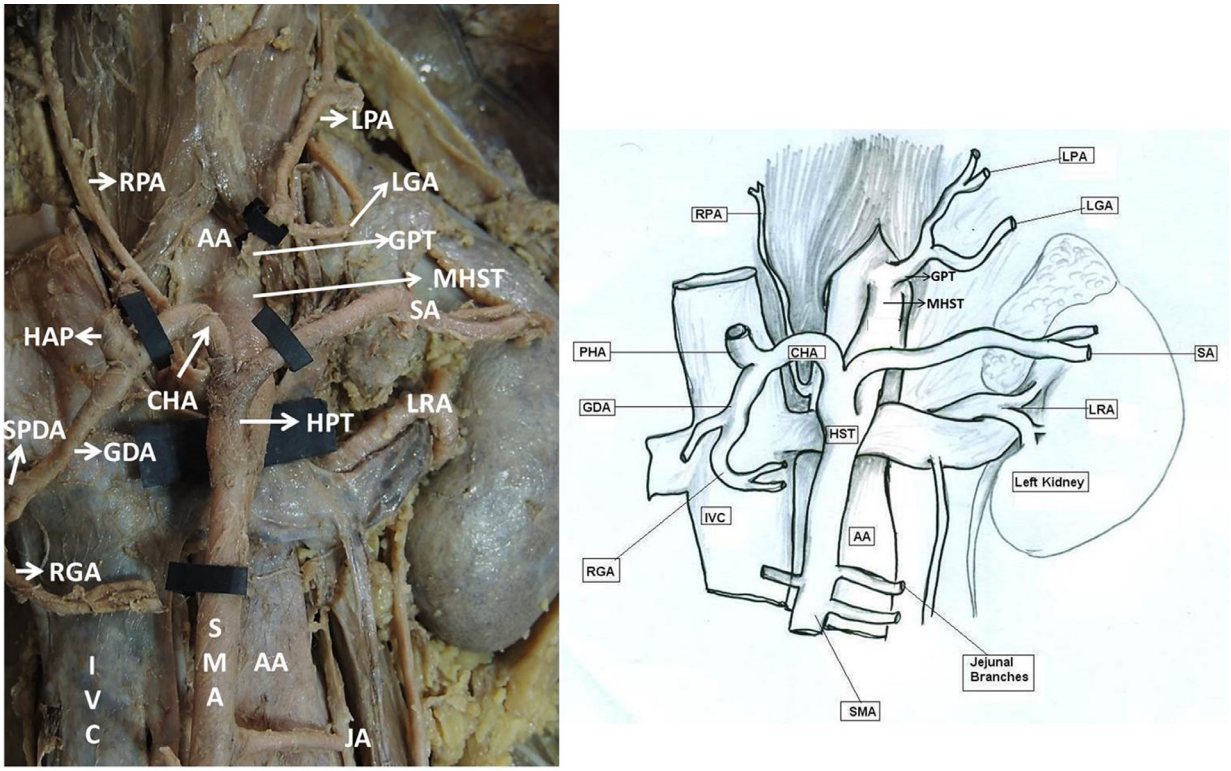

Figure 2: Case 2–Immediately after entering to abdomen through the aortic opening, the abdominal aorta (AA) gave rise to small gastrophrenic trunk (GPT) which further divided into left phrenic artery (LPA) and left gastric artery (LGA). Just below the this small trunk, another large mesentrico-hepato-splenic trunk (MHST) was arising from the AA which then divided into Hepato-splenic trunk (HPT) and Superior mesenteric artery (SMA). HPT then divided into Splenic (SA) and common hepatic arteries (CHA). After the short course, CHA was further divided into Hepatic artery proper (HAP) and gastroduodenal artery (GDA). Abbreviations: RPA= right phrenic artery, LRA = left renal artery, JA = first jejunal artery, IVC = inferior vena cava.

surgeries and liver transplantation. Knowledge of the abnormal origin of the splenic artery should be kept in mind as they become significant in splenectomy and laparoscopic assisted gastrectomy, where the operative field is relatively limited. There might be chance of ligation or division of wrong vessel, which may lead to necrosis or bleeding.

Normally, inferior phrenic artery arises from abdominal aorta as its one of the lateral branches. Michels in his dissection found the origin of inferior phrenic artery from the abdominal aorta as a common trunk with common hepatic artery (incidence of 9.6%) or in isolation (1.6% of cases) (1). In our second case, left inferior phrenic and gastric arteries arose as a common trunk (phrenico-gastric trunk) which is a very rare variation and has not been reported so far. However, the other case shows the origin of the left gastric and splenic arteries as a gastrosplenic trunk which again is a rare variation with an incidence of 5.5% (1,10).

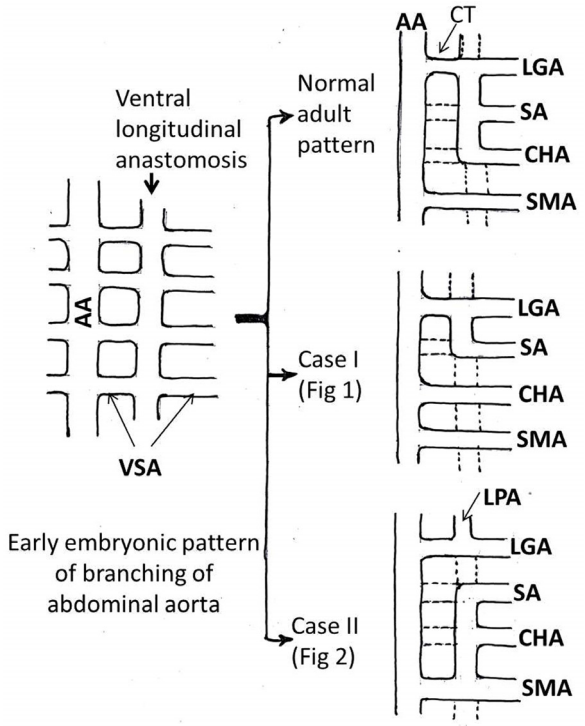

Figure 3: Schematic representation (Lateral view) showing the normal developmental pattern of celiac trunk (CT) arteries and superior mesenteric artery (SMA) and probable developmental reasons for the variations observed in our cases. Abbreviations: AA = abdominal aorta; VSA = ventral splanchnic arteries; LGA = left gastric artery; SA = splenic artery; CHA = common hepatic artery; SMA = superior mesenteric artery; LPA = Left phrenic artery.

The anomalous origin and course of the inferior phrenic artery is significant in intra-vascular procedures like arterial chemoembolization to prevent the spread of hepatic carcinoma and transarterial embolisation to prevent blood loss in patients with severe hemoptysis (1,8, 11). During gastrectomy or splenectomy, the short gastric and splenic vessels are isolated and ligated. Therefore, during laparoscopic surgeries, lack of awareness of these variations and limited operative field may lead to post-operative hemorrhage and ischemia or necrosis of the concerned organs.

Developmentally the sub-diaphragmatic ventral splanchnic arteries were paired initially and interconnected by the ventral and dorsal splanchnic anastomotic channels to supply the gut. Between sixth to tenth weeks of gestation, the mid gut undergoes rapid growth in a considerably smaller peritoneal cavity resulting in herniation, rotation and reposition. These changes alter hemodynamic changes in the developing gut to a larger extent resulting in reduction of number of ventral splanchnic arteries into three as celiac trunk, superior and inferior mesenteric arteries (Figure 3). Alteration in either persistence or disappearance these anastomotic channels and roots of these vessels may lead to variations in the celiaco-mesenteric origin and their branching patterns (11,12). Our findings and embryological reasons are in well correlation with above said description and disagree with the organogenetic explanation given by Marian and his colleagues as they described their variations of hepatogastric trunk and splenomesenteric trunks would be from right and left yolk arteries (13).

Conclusion

The complex variations in the celiac trunk branches presented in our case series are rare and highly significant as the celiac trunk is the sole artery to the upper abdominal viscera. Pre-operative knowledge of such rare variations is essential for clinicians to accomplish successful surgeries, diagnostic and therapeutic vascular intervention procedures and liver transplantations.

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Conflicts of Interest

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Authors' Contributions

Conception and design: PLC, KMRB
Drafting of the article: PLC
Critical revision of the article for important intellectual content: KMRB
Final approval of the article: PLC, SGK, KMRB
Provision of study materials or patients: RA
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Correspondence

Dr Kumar MR Bhat
PhD (Kasturba Medical College, Manipal University)
Department of Anatomy
Kasturba Medical Collage
Manipal University
Manipal-576104, India
Tel:+91-820-292 2327
Fax: +91-820-257 0061
Email: kumar.mr@manipal.edu

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