Anatomical Variations in Coeliac Trunk and Its Branches

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Research Article

Abstract: Coeliac trunk is the first anterior branch of abdominal aorta at the level of lower border of twelfth thoracic vertebra. Hepatic, splenic and left gastric arteries are the three main classic branches of coeliac trunk. The variations of the coeliac trunk are common but asymptomatic; they may become important during surgeries and in some radiological procedures. The aim of this study is to describe such variations. During routine dissection on adult cadavers in Anatomy department, we found some variations in the branching pattern of the coeliac trunk. The left gastric artery arises as first branch of coeliac trunk and then the trunk bifurcates into splenic and hepatic arteries. Right gastric artery is seen originating from the left hepatic artery. In addition, one right aberrant hepatic artery from superior mesenteric artery is seen entering into right lobe of liver. Left inferior phrenic artery and dorsal pancreatic artery are found originating from the coeliac trunk. Left gastric artery normally originates from the coeliac trunk, but in our study it is arising directly from the abdominal aorta. Knowledge of variations found in the present study will be very useful in surgical, oncologic or interventional procedures and can be kept in mind to avoid complications.

Keywords: Coeliac trunk, Variations, Left gastric artery, Splenic artery, Common hepatic artery, Right gastric artery, Left inferior phrenic artery.

Introduction

According to standard anatomical textbook descriptions, the coeliac trunk gives off three main branches: the splenic artery, the hepatic artery and the left gastric artery. The hepatic artery is further subdivided into a common hepatic part, which extends from the coeliac trunk to the origin of the gastroduodenal artery and the hepatic artery proper, which extends from that point to its bifurcation[(1)]. The branches of coeliac trunk namely left gastric, common hepatic and splenic arteries supply the primary organs of the supracolic abdominal compartment namely the stomach, pancreas, spleen and liver. This trifurcation was first described by Haller in 1756. This "Tripus Halleri" was and is still being considered to be the normal appearance of the coeliac trunk[(2)]. Many variations have been reported in the branching pattern of the coeliac trunk like quadrifurcation of coeliac trunk[(3)], anomalous origins of different arteries from coeliac trunk other than usual three main branches[(4)], pentafurcation of the trunk[(5)] and even absence of coeliac trunk[(6)]. Arterial vascularisation of the gastrointestinal system is provided by anterior branches at three different levels of the abdominal aorta (the coeliac trunk and the superior and inferior mesenteric arteries). Differences in the embryonic process which arise during several developmental stages lead to a range of variations in these vascular structures. Anatomic variants of the coeliac trunk is essential to successfully accomplish surgical, oncologic, or interventional procedures including lymphadenectomy around hepato-splenomesenteric trunk, aortic replacement with reimplantation of the trunk, or chemoembolization of liver malignancies, all of which can potentially create significant morbidity because of the large visceral territory supplied by a single vessel[(7)].

Materials and Methods

This study was conducted on 50 cadavers (13 females and 37 males) which were used during the routine dissection for the medical undergraduates in the Department of Anatomy, Alluri Sitarama Raju Academy of Medical Sciences, Eluru, A.P., India. Abdomen was dissected as per Cunningham's manual to observe the coeliac trunk and its branches. All the branches of coeliac trunk were carefully dissected and photographed using digital camera.

Results

During a routine dissection of the cadavers for undergraduate MBBS batches, the following variations of the coeliac trunk were found. Pancreas is supplied by the ventral and dorsal anastomoses of superior and inferior pancreatico-duodenal arteries and the branches of splenic artery. Sometimes a dorsal pancreatic branch, derived from splenic artery or from coeliac trunk, supplies the posterior surface of the pancreas. In one specimen (Figure 1), dorsal pancreatic artery arose from the coeliac trunk. In another cadaver, the left gastric artery was found to be

arising as a first branch of coeliac trunk, then the next part of trunk (hepatosplenic trunk) bifurcates into splenic and hepatic arteries (Figure 2). Right gastric artery usually arises from the common hepatic artery. We observed in one cadaver that right gastric artery was arising from the left hepatic artery (Figure 3). Figure 4 showed that right and left hepatic arteries were found dividing into segmental branches before entering into the liver. In this present study, one additional right aberrant hepatic artery was found arising from superior mesenteric artery and entering into the right lobe of liver in addition to usual the right hepatic artery (Figure 5). Inferior phrenic arteries are considered as the first branches of the abdominal aorta and both arteries give off superior supra-renal branches to corresponding adrenal glands. Mburu et al[8] did a study of 123 specimens at Kenyatta National hospital, Nairobi, Kenya and observed that the Coeliac trunk was trifurcated in 61.7%, bifurcated in 17.9% and gave collateral branches in 20.3%. Generally additional branches of Coeliac trunk other than the normal branches are referred to as collaterals. Collaterals observed included dorsal pancreatic, gastroduodenal, inferior phrenic and ileal arteries. Dorsal pancreatic was the most common collateral occuring in 14.8% of cases, while inferior phrenic was found in 4.9%, in our study left inferior phrenic artery was seen arising from the coeliac trunk (Figure 6). The left gastric artery is the smallest branch of coeliac trunk, but it is the principal artery of stomach. In one cadaver, left gastric artery was found originating directly from the abdominal aorta (Figure 7). The coeliac trunk had its usual branching pattern in 43 cadavers but we found variations in the branching pattern of coeliac trunk in seven cadavers.

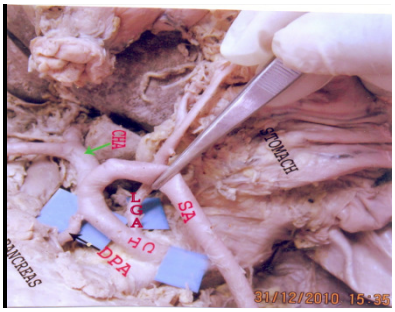

Figure 1: *showing origin of dorsal pancreatic artery from the coeliac trunk. CT- Coeliac trunk, DPA- Dorsal Pancreatic artery, SA-Splenic artery, LGA- Left gastric artery, CHA-Common Hepatic artery*

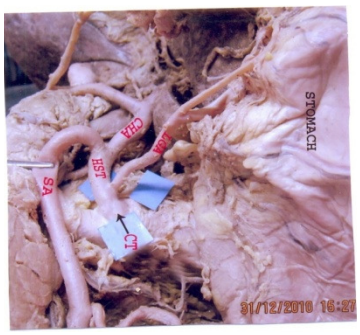

Figure 2: *showing origin of left gastric artery as a first branch of coeliac trunk. CT- Coeliac trunk, SA-Splenic artery, CHA-Common Hepatic artery, LGA- Left gastric artery, HST-Hepato-splenic Trunk*

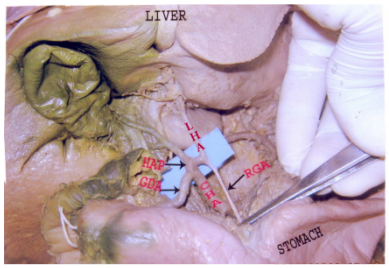

Figure 3: *showing origin of right gastric artery from the left hepatic artery. LHA- Left hepatic artery, CHA- Common Hepatic artery, RGA- Right gastric artery, HAP- Hepatic artery Proper. GDA- Gastroduodenal artery*

Figure 4 *showing early divisions of right and left hepatic arteries into segmental arteries. LHA- Left hepatic artery, CHA- Common Hepatic artery, RHA- Right hepatic artery, GDA- Gastroduodenal artery, SA- Splenic artery.*

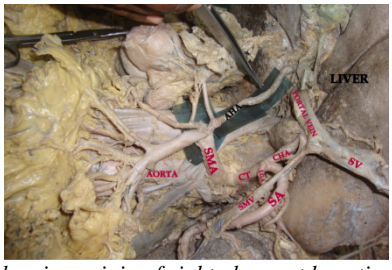

Figure 5: *showing origin of right aberrant hepatic artery from superior mesenteric artery. CHA- Common hepatic artery, SMA- Superior mesenteric artery, AHA- Aberrant hepatic artery, CT- Coeliac trunk, SA- Splenic artery, LGA- Left gastric artery, SV- Splenic vein, SMV- Superior mesenteric vein*

Figure 6: *showing origin of left inferior phrenic artery from the coeliac trunk. CT- Coeliac trunk, LIPA- Left inferior phrenic artery, LSG-Left Suprarenal gland, LGA- Left gastric artery*

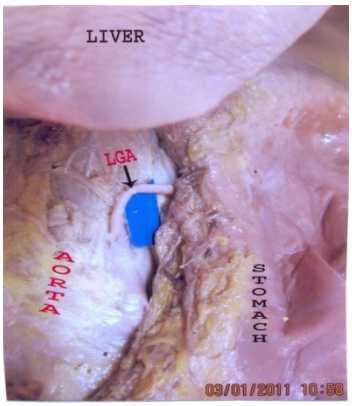

Figure 7: *showing origin of left gastric artery directly from the abdominal aorta. LGA- left gastric artery*

Discussion

Variations in the branches of the coeliac trunk are the most commonly reported ones and many authors have reported different variation patterns. Vascular variations are usually asymptomatic. They may become important in patients undergoing coeliacography for gastrointestinal bleeding, coeliac axis compression syndrome, prior to an operative procedure or transcatheter therapy; chemoembolization of pancreatic and liver tumors[9].

The types of coeliac trunk according to Michels[10] classification are as follows:

Type 1: Normal branching –Trifurcation.

Type 2: Hepatosplenic trunk and left gastric artery from aorta.

Type 3: Hepatosplenomesentric trunk and left gastric from aorta.

Type 4: Hepatogastric trunk and splenic artery from superior
mesenteric artery.

Type 5: Splenogastric type; splenic and left gastric from the coeliactrunk and common hepatic artery from superior mesenteric artery.

Type 6: Coeliacomesentric trunk; splenic, left gastric, common hepatic and superior mesenteric arteries arise from a common trunk

Dorsal pancreatic artery from the coeliac trunk:

Mburu KS et al[8] dissected 123 cadavers in Nairobi and observed that dorsal pancreatic artery was arising from the coeliac trunk in 14.8% of cases. Bergman, Thompson, Afifi et al[11] have reported some of the variations of the dorsal pancreatic artery which arose from the splenic artery (37%), the coeliac trunk (33%), the superior mesenteric (21%), and the common hepatic artery (8%).

Left gastric artery as first branch of coeliac trunk:

Eaton[12] found the most common type of branching of coeliac trunk in which left gastric artery was given off first and remaining trunk then bifurcate into hepatic and splenic arteries and he observed it in 62.1% of cases of 541 specimens. Michels[10] found this variation in 20% of cases.

Right gastric artery from the left hepatic artery:

Nayak SB et al[13] reported that the right gastric artery took its origin from the left hepatic artery within the porta hepatis and descended down in the lesser omentum. Lipshutz[14] observed the same. The current variation of the origin of the right gastric artery from the left hepatic artery might be of additional advantage to pass a catheter into left hepatic artery through it to embolize the left hepatic artery[13].

Though the variations of the common hepatic artery are rare, the right and left hepatic arteries show many variations in their course, branching and distribution. Song et al. [15] did an extensive study on the common hepatic artery and found variations in only 3.71% of cases. In the present study the right and left hepatic arteries were found dividing into branches before entering into the liver in one male cadaver.

Right aberrant hepatic artery from superior mesenteric artery:

The origin of accessory hepatic artery from the superior mesenteric artery is very rare. Nayak S.B. et al[13] reported an accessory hepatic artery arising from the proximal part of the superior mesenteric artery. Its close relationship with the head of the pancreas, first part of duodenum and the portal vein makes it vulnerable during surgeries in this area. The knowledge of this kind of vascular variation may be useful for surgeons doing liver transplants, pancreatic mobilizations and gastro-jejunostomies. Yuksel et al.[16] in their study found an extremely long celiac trunk. They also found an inferior phrenic artery arose from coeliactrunk and an aberrant right hepatic artery derived from the superior mesenteric artery.

Left inferior phrenic artery from the coeliac trunk:

Lipshutz[14] observed the left inferior phrenic artery arising from the coeliac trunk in 7.25% of cases and Adachi[17] reported in 8.1% of cases. Mburu KS et al[8] found this variation in 4.9% of cases. Pamidi Narendra et al[7] discovered a left inferior phrenic artery as direct

branch of coeliac trunk in a 45 year old male cadaver. The knowledge of this type of variation is important for the surgeons performing kidney transplants and suprarenal surgeries[9].

Left gastric artery from abdominal aorta:

Left gastric artery is the smallest branch of the coeliac trunk and more commonly originates before the coeliac trunk ends by bifurcating into hepatic and splenic arteries. Lipshutz[14] found it arising from the aorta, just above the origin of the remaining coeliac trunk in 15% of cases. Similarly Eaton[12] found it 4.5% of cases. Yildirim M et al[18] also reported aortic origin of left gastric artery. This variation may be important in operative procedures on the supracolic organs, in stomach resection, and during dissection of lymph nodes along this artery in gastric cancer.

Conclusion

Anatomic variations of the coeliac trunk are due to developmental changes in the ventral segmental (splanchnic) arteries. Presence of additional arteries may provide collateral circulation which may be important during transplant surgeries. Anatomical variations in the branching pattern of the coeliac trunk are of considerable importance in liver transplants, laparoscopic surgery, radiological abdominal interventions and penetrating injuries to the abdomen[19]. Knowledge of these variations is very useful in surgical, oncologic or interventional procedures and should be kept in mind to avoid complications. Complications in abdominal surgeries can be avoided with an accurate knowledge of the anatomical variations of the coeliac trunk.

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