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Case Report

Anatomy Section

Variations in the Branching Pattern of the Coeliac Trunk

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ABSTRACT

The knowledge on the anatomical variations of the abdominal aorta is important due to its clinical significance. The variations of the coeliac trunk are common but asymptomatic; they may become important during surgeries and in some radiological procedures.

The coeliac trunk, in the present case report, in addition to the left gastric, splenic and the common hepatic arteries, was also giving origin to the accessory right hepatic artery and to both the right and the left inferior phrenic arteries. The hepatic artery proper was trifurcating into two right hepatic arteries and one left hepatic artery. The cystic artery was arising from the accessory right hepatic artery, instead of taking origin from the right hepatic artery. The left gastric artery was giving origin to the accessory left hepatic artery.

The findings of our case study could help in minimizing the operative and the post-operative complications which are related to abdominal surgeries and they may facilitate better and accurate radiological interpretations. The clinical implications of the variations have been stressed upon.

Key Words: Coeliac trunk, Left gastric artery, Cystic artery, Accessory hepatic artery, Inferior phrenic artery

INTRODUCTION

The Coeliac Trunk (CT) is the first ventral branch of the abdominal aorta and it arises just below the aortic hiatus, at the level of the intervertebral disc, between the T12 and the L1 vertebrae. It is 1.5cm-2cm long and it divides into the left gastric (LGA), the common hepatic (CHA) and the splenic arteries (SA) [1]. This usual branching pattern is referred to as a classical trifurcation and it was observed by Haller as Tripus Halleri. The branching pattern may vary from a classical trifurcation to an abnormal trifurcation, a bifurcation, a quadrifurcation, a pentafurcation and even an exafurcation of the trunk [2]. The prevalence of this trifurcation has been reported by Malnar et al., (72%) [3], Song et al., (89.1%) [4], Ugurel et al., (89%) [5], Bergman et al., (86%) [6] and Prakash et al., (86%) [7].

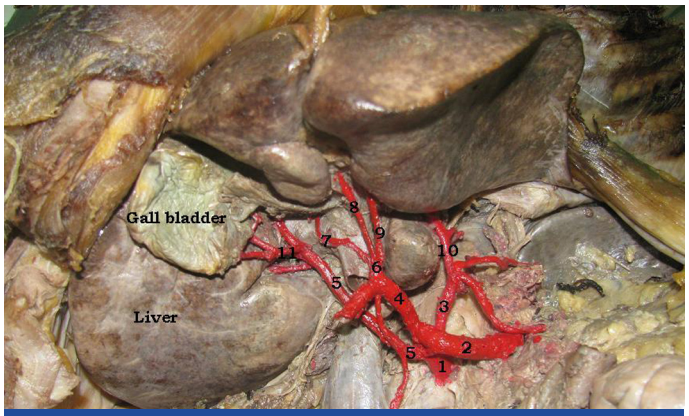
Though the variations in the CT are usually common but asymptomatic, they may become important in the patients who undergo a diagnostic angiography for gastrointestinal bleeding or prior to an operative procedure. Recognizing these variations, enables the clinicians in distinguishing the features which merit further investigations and treatment. The aim of the present cadaveric case study was to describe the variations in the branching pattern of the CT and its clinical implications.

CASE REPORT

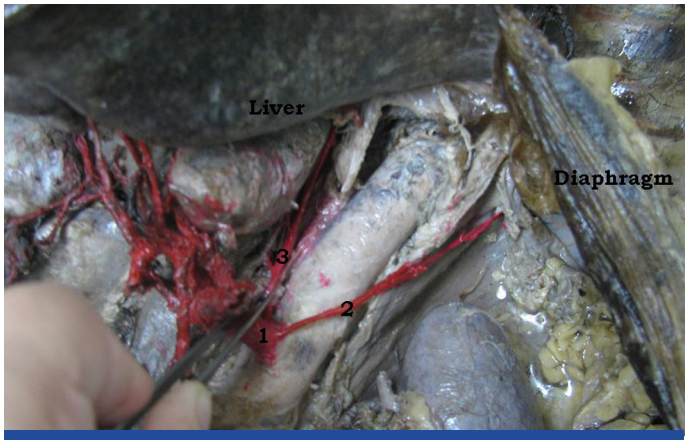
During the routine dissection teaching of the abdominal region to undergraduate students in the Anatomy Department, MSRMC, Bangalore, India. we found a variation in the branching pattern of the CT in an adult male cadaver which was aged 60 years. All the branches were carefully dissected and photographed.

OBSERVATION

The CT was 1.5cm long and it arose from the ventral surface of the abdominal aorta, at the level of the intervertebral disc, between the T12 and the L1 vertebrae. It gave origin to the right and the left inferior phrenic arteries and to the accessory right hepatic arteries (ARHA), instead of its usual three branches.



[Table/Fig-1]: Coeliac trunk showing variant branching pattern. 1. CT, 2. SA, 3 LGA, 4. CHA, 5. ARHA, 6. PHA, 7 & 8. RHA 9. LHA, 10. ALHA, 11. CA



[Table/Fig-2]: Variation in the origin of Inferior Phrenic Arteries 1. CT, 2. RIPA, 3. LIPA

The LGA was the smallest branch, it coursed upwards and to the left and about 4cm from its origin, the accessory left hepatic artery was given off. The calibre of this accessory left hepatic artery was the same as that of the LGA, which entered the liver between the caudate and the left lobes of the liver.

The CHA was slightly larger than the LGA in caliber passing towards right and at the right free margin of lesser omentum, it provided origin to right gastric and gastroduodenal artery as usual. It continued upwards later as the proper hepatic artery and trifurcated immediately, giving two branches to the right lobe and one branch to the left lobe, all being 2mm in diameter. The right hepatic artery, without giving the cystic artery, entered the right lobe of the liver.

The SA was the largest branch of the CT without any variations. The ARHA was approximately 4mm in diameter and 2 times wider than the hepatic arteries, traversing behind the common hepatic duct. About 8cm from its origin, a branch was given off, which entered the inferior surface of the right lobe. Further, at about a distance of 0.5cm-1cm, the cystic artery originated and at the neck of the gall bladder, it divided into the superficial and the deep branches. Finally, the ARHA terminated at the inferior surface of the right lobe of the liver [Table/Fig-1].

Both the right and the left inferior phrenic arteries arose independently from the right and left contours of the CT respectively. The right inferior phrenic artery was 0.6mm in diameter, whereas the left inferior phrenic artery was 0.4mm in diameter. Both these branches terminated themselves on the abdominal surface of the respective domes of the diaphragm. [Table/Fig-2].

DISCUSSION

The anatomical variations of the CT were first classified by Adachi and Michels in 1928, based on 252 dissections on Japanese cadavers, where six types of divisions of the CT and the superior mesenteric artery were described [8,9]. The types of CT according to Michel's classification [9] are as follows:

Type1: normal branching,

Type 2: the hepatosplenic trunk and the LGA from the aorta.

Type 3: the hepatosplenomeseteric trunk and the LGA from the aorta.

Type 4: the hepatogastric trunk and the SA from the superior mesenteric artery.

Type 5: the SA and the LGA from the CT and the CHA from the superior mesenteric artery.

Type 6: the coeliacomesenteric trunk, the SA, the LGA, the CHA and the superior mesenteric artery arise from a common trunk.

Lipshutz gave a detailed account of the CT, based on the mode of origin and the distribution of the gastric, splenic and the hepatic arteries and classified his findings into 4 types.

Type I: (75% cases) The coeliac axis (CA) was the common trunk of origin for the LGA, the SA and the CHA.

Type II: (15% cases) The HA and the SA arose from the CT, but the LGA had a varied origin, either from the HA or directly from the abdominal aorta.

Type III: (6% cases) The LGA and the HA took origin from the CA, but the SA was a separate branch from the abdominal aorta.

Type IV: (4% cases) The CA was the trunk of origin for the gastric artery and the SA, but the CHA occurred as a separate branch from the aorta [10]. Wadhwa reported that among his 30 cases, type 1 CA was found in 28 cases and that the type 2 CA was found in 2 cases [11].

The anamolous origins of the cystic artery are commonly encountered during cholecystectomy. The variant origins of the cystic artery include its origin from the left hepatic artery (4%), the gastroduodenal artery (1.4%), the superior pancreaticoduodenal and the retroduodenal arteries (1.4%), CT (1.4%) and from the superior mesenteric artery (1.4%) [12]. Hlaing [12] observed a unique origin of the cystic artery from the middle hepatic artery, which was a branch from the right hepatic artery, which ended in the quadrate lobe of the liver. Michels quoted the term, MHA, which is the extrahepatic branch of the RHA or the LHA that supplies the caudate and the quadrate lobes of the liver [13]. A detailed anatomical knowledge on the cystic artery is very important for the surgeons and the radiologists who perform laparoscopic cholecystectomies and intraoperative cystic angiograms during hepatobiliary surgeries respectively [14].

The patterns of the arterial supply of the liver are variable. The modifications of the dominant scheme in which the liver receives its total inflow from the hepatic branch of the coeliac axis, occurs in 25-75% of the cases. The surgical anatomy of the hepatic arteries in 1000 cases, has been reported by Hiatt et al., [15]. The arterial pattern in the order of frequency, included the normal type 1 anatomy (n=757), with the CHA arising from the CA to form the gastro duodenal and the proper hepatic arteries. Type 3(n=106), A replaced or the ARHA originating from the superior mesenteric artery.

Type 2(n= 97) with a replaced or the accessory left hepatic artery arising from the LGA, as was noted in our case. Type 4(n=23), with both the right and the left hepatic arteries arising from the superior mesenteric artery and the LGA respectively.

Type 5(n=15), with the entire CHA arising as a branch of the superior mesenteric artery. Type 6(n=2), with the CHA taking direct origin from the aorta. This classification is modified from ten variants to six variants to reflect the presence of the vessels that were either accessory or replaced. These variant patterns are relevant, as they will affect the laparoscopic appearance of the porta hepatis.

Yalcin et al., observed in a 25 year old Turkish female cadaver, that the left inferior phrenic artey and the LGA originated from the CT via a common trunk [16]. Petrella et al., observed, that in 31 cadavers out of 89 cadavers which they dissected, the inferior phrenic artery had its origin from the CT [17]. The knowledge on this type of variation showed that the surgeons must be cautious, to avoid an unintentional sectioning of the small calibre arteries and that these vascular anomalies may become important in patients who undergo a diagnostic angiography for gastrointestinal bleeding and prior to trans catheter therapies.

CONCLUSION

The arterial variations should not be ignored and with an accurate knowledge on the anatomical variations, many operative and post operative complications can be avoided. The knowledge on the CT variations would enable the radiologists in protecting the important vessels prior to transcatheter therapies, and also in preventing inadvertent injuries. The anatomy of the hepatic artery is of great importance in hepatic surgeries, especially in liver transplantation and in many radiological procedures, to ensure complete arterializations of the grafts, which can prevent necrosis of the liver parenchyma post-operatively.

A thorough knowledge on the vascular pattern of the cystic artery and its relations is important for the surgeons who conduct lap-

aroscopic cholecystectomies and it also helps the radiologists in performing intra-operative cystic angiograms.

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