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RESEARCH ARTICLE

COELIAC TRUNK AND LEFT GASTRIC ARTERY VARIATION: A CLINICAL INTERPRETATION

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ABSTRACT

Background: The coeliac trunk (hepatolienogastric trunk or "Tripus Hallery") is the most important artery of the foregut. It arises at the level of T12 vertebra from the abdominal aorta. The branches of coeliac trunk (left gastric, common hepatic and splenic) considered as the normal appearance. The coeliac trunk variations have been reported which are common and usually asymptomatic. Left gastric artery variations are very rare and awareness of such anatomical variations has become specifically important in patients undergoing hepatobiliary surgeries and liver transplantation to avoid serious ischemic complications. Therefore, it was aimed to study the coeliac trunk and its branching pattern. **Objective:** The present study is aimed to investigate anatomical variations of the coeliac trunk and left gastric artery. **Methods:** The present study was carried out on 42 cadavers of age 60-80 years who were allotted to 1st year MBBS students for routine dissection during the period of last 4 years in Department of Anatomy, AIIMS, New Delhi. Dissection was done to identify the coeliac trunk and its branches. The branches were traced from origin to termination. **Results:** We observed three unusual variations in arterial patterns of the coeliac trunk in 42 cadavers. The middle colic artery was arising from coeliac trunk which was supplying the uncinate process of pancreas and transverse colon. In another two cases we observed an accessory branch arising from left gastric artery which was supplying the left lobe of liver and cardiac end of stomach. **Conclusion:** The knowledge of deviations from the normal arterial pattern of gastrointestinal tract is of immense significance for surgical and radiological procedures pertaining to the liver and adjacent viscera.

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INTRODUCTION

Embryologically, the gastrointestinal tract is divided into three parts on the basis of its vascular supply (foregut, midgut and hindgut). The foregut (from lower 1/3rd of oesophagus to middle of 2nd part of duodenum,) is supplied by the coeliac trunk (CT). The coeliac trunk is the first branch from the ventral aspect of abdominal aorta and arises opposite to lower border of the T 12 vertebra (Standring, 2016). It precedes in forward direction and slightly right to the midline just above the upper margin of the pancreas and splenic vein (Standring, 2016). In 72–90% of the normal population the coeliac trunk trifurcates into left gastric, splenic and common hepatic arteries (Matoba et al., 2003). The superior mesenteric artery, the main contributor of midgut, is the second branch arises from ventral aspect of the abdominal aorta at body of L1 vertebra. It gives inferior pancreatico-duodenal, middle colic artery, illiocolic, jejunal and ileal branches.

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However in 0.5-1% of cases the middle colic artery may arise from the coeliac trunk (Yildirim et al., 2004). In 1928, Adachi classified the altered branching pattern which was arising from the ventral aspect of abdominal aorta(Adachi, 1928). The knowledge of CT variation is important for planning various surgeries and intervention procedures like laparoscopic surgeries, liver transplantation, gastric resection, angiography to avoid vascular complications. Therefore, the present study is aimed to investigate anatomical variation of CT.

MATERIALS AND METHODS

The present study was carried out on 42 cadavers of age 60-80 years who were allotted to 1st year MBBS students for routine dissection during the period of last 4 years in Department of Anatomy, All India Institute of Medical Sciences (AIIMS), New Delhi. The anterior layer of peritoneum was removed from the lesser omentum of stomach. After removing remainder of lesser omentum we identified coeliac trunk arose from abdominal aorta and its branches (Romanes, 2016). The branches of CT were traced from origin to termination.

RESULTS

In the present study of 42 cadavers (32 males and 10 females) CT and its branching pattern were observed (Table 1). In 1/42 (2.38%) cases the coeliac trunk had 4 branches. Four branches of CT were observed in 1/32 male cadaver where as 3 branches (left gastric, splenic and common hepatic arteries) were observed in 10/10 female cadavers. We observed an accessory branch (diameter 1.4 cm) from the coeliac trunk in 60 year old male cadaver, in addition to the usual branches. On further exploration, this accessory branch ran antero-inferiorly for 4cm and bifurcated, the one moved upward for 5 cm to supply the uncinate process of pancreas while the other ran downwards for 5 cm to supply the transverse colon (Fig 1). The branch which was supplying transverse colon again divided into right (6 cm) and left (12 cm) branches to arborise the transverse colon completely, thereby forming anastomotic network with right colic and left colic artery respectively. No branch from superior mesenteric artery was seen to supply the transverse colon. Hence, in this study the middle colic artery (MCA) was actually originated from the coeliac trunk.

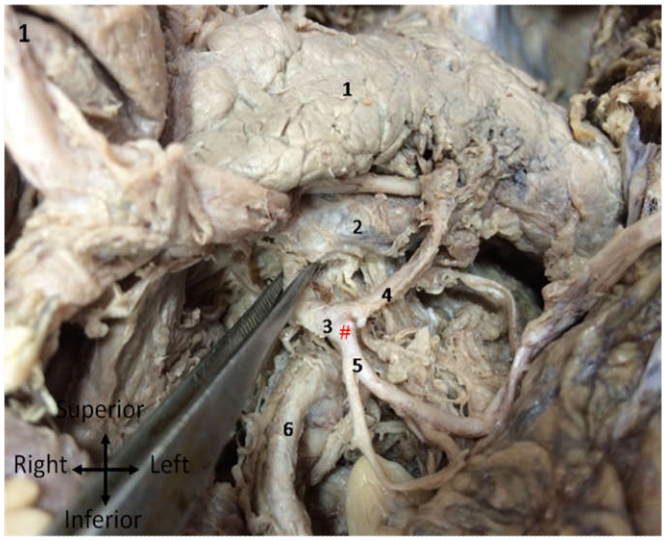

Fig. 1. Variation of branching pattern of celiac trunk. CT was divided into left gastric artery, splenic artery and common hepatic artery.Note pancreas, celiac trunk, middle colic artery and its branches and superior mesenteric artery.1- Pancreas, 2-Celiac trunk, 3-(#) Middle colic artery, 4-Branch of middle colic artery to the pancreas, 5-Branch of middle colic artery to the transverse colon,6-Superior mesenteric artery.

We observed two variations in which accessory branch arose from left gastric artery in 65 year old female cadaver and 67 year old male cadaver respectively. In both variations the coeliac trunk was originated at T12 vertebra from ventral aspect of abdominal aorta, which was 1.3 cm in diameter. After coursing 1.2 cm ventrally in 1st variation and 1.4 cm ventrally in 2nd variation they were trifurcated in usual pattern i.e. left gastric, common hepatic and splenic arteries. An accessory branch arose from the left gastric artery approximately 4 cm in 1st variation and 4.1 cm in 2nd variation from its origin adjacent to the upper end of the lesser curvature. These accessory artery bifurcates which was supplying the left lobe of liver (6.5 cm from its origin in 1st variation and 7.4 cm from its origin in 2nd variation) and the cardiac end of stomach (6 cm from its origin in 1st variation and and 5cm from its origin in 2nd variation) [Fig2a, 2b and 3].

Fig. 2a & 2b- Variation in branching pattern of the CT arising from the abdominal aorta. CT was divided into left gastric artery, splenic artery and common hepatic artery. Note the left gastric artery gave an accessory left hepatic artery which was supplying left lobe of liver and cardiac part of stomach. 1- Stomach,2-Left lobe of liver,3-Pancreas,4- Gall bladder,5-Caudate lobe of liver,6- Common bile duct,7- Portal vein,8- Coeliac trunk,9- Left gastric artery,10- Common hepatic artery,11- Splenic artery,12- Gastroduodenal artery,13- Right gastric artery,14- Hepatic artery,15-(#) Accessory left hepatic artery,16-(#) Cardiac branch from accessory left hepatic artery

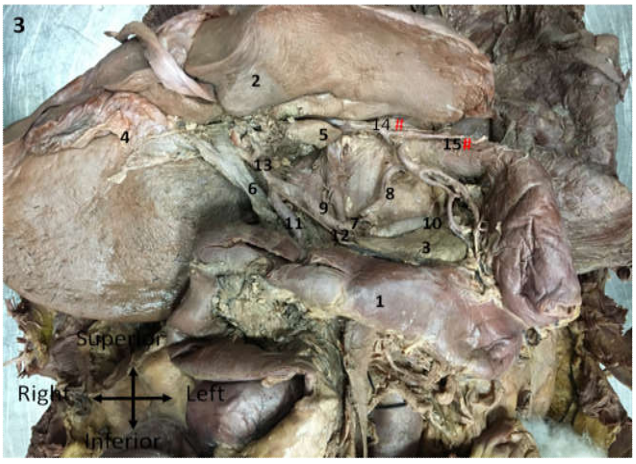

Fig 3- Variation in branching pattern of the CT arising from the abdominal aorta.CT was divided into left gastric artery, splenic artery and common hepatic artery. Note the left gastric artery gave an accessory left hepatic artery which was supplying left lobe of liver and cardiac part of stomach.1-Stomach,2-Left lobe of liver,3-Pancreas,4- Gall bladder,5-Caudate lobe of liver,6- Common bile duct,7- Coeliac trunk,8- Left gastric artery,9- Common hepatic artery,10- Splenic artery,11- Gastroduodenal artery,12- Right gastric artery,13- Hepatic artery,14-(#) Accessory left hepatic artery,15-(#) Cardiac branch from accessory left hepatic artery

Table 1. Branching pattern of coeliac trunk.

Branching patterns of CT	Male (Total =32)	Female (Total=10)
Three branches	31/32	10/10
Four branches	1/32	0/10

Table 2. Classifications of hepatic arterial types (Michel's and Hiatt's classifications) (Hiatt, 1994) (LHA-left hepatic artery; LGA-left gastric artery; RHA-right hepatic artery; SMA - superior mesenteric artery; CHA-common hepatic artery)

Type	Description	Percent
1	Normal	55
2	Replaced LHA from LGA	10
3	Replaced RHA from SMA	11
4	Replaced RHA + LHA	1
5	Accessory LHA	8
6	Accessory RHA	7
7	Accessory RHA + LHA	1
8	Replaced RHA + Accessory LHA or Replaced LHA + Accessory RHA	2
9	CHA from SMA	2.5
10	CHA from LGA	0.5

DISCUSSION

In the present study, 4 branches of CT were observed in one male cadaver and left gastric artery gave an accessory branch in one female cadaver and one male cadaver. These variations reflects developmental etiology, probably may be due to abnormal development of the subdiaphragmatic ventral splanchnic branches of the dorsal aorta or may be due the abnormal ventral and dorsal splanchnic anastomosis (Standring, 2006). The coeliac, superior mesenteric and inferior mesenteric artery was developed from three abdominal vitelline arteries. The coeliac artery gradually descends down up to twelfth thoracic vertebra which was initially unites with the dorsal aorta at seventh cervical vertebra. This coeliac artery not only supplies the foregut but also the embryonic outgrowth of the foregut. At the level of 2nd thoracic vertebra, the SMA (Superior mesenteric artery) unites with dorsal aorta initially and gradually descends to the first lumber vertebra (Gary, 2009). The anomalies of these arteries have embryological basis which were observed on human adults (Morita, 1935; Sato et al., 1993) and on sheep (Wustinger, 1978).

The reasons for these anomalies could be due to disappearance of the roots of the primitive ventral splanchnic arteries and their anastomoses (Morita, 1935). Several researchers have classified branching of coeliac trunk into varied types. According to Lipshutz the branching pattern of CT is divided into four types- type 1(origin of gastric, splenic and hepatic arteries arise from CT), type 2 (only hepatic and splenic artery arise from CT), type 3 (only hepatic and gastric arteries arise from CT), Type 4 (only gastric and splenic arteries arise from CT) (Lipshutz, 1917). According to Uflacker the branching pattern of CT is divided into eight– normal trifurcation of CT, hepatosplenic trunk, hepatogastric trunk, hepatosplenomesenteric trunk, gastrosplenic trunk, celiacomesenteric trunk, coelia-colictrunk, no coeliac trunk) (Uflacker, 1997). Adachi classified CT into hepatogastrosplenic trunk, hepatosplenic trunk, hepatosplenomesenteric trunk, coeliacomesentric trunk, hepatomesenteric and gastrosplenic trunk (Adachi, 1928). Michels classified CT into 7 types: type 1(normal trifurcation of CT),type 2 (hepatic and splenic arteries from CT), type3 (hepatic and splenic and superior mesenteric arteries from CT), type 4(hepatic and gastric arteries from CT), type 5 (splenic and gastric arteries from CT), type 6 (superior mesenteric arises combination with the CT), type 7(the middle or an accessory middle colic from the CT) (Micahels, 1951). According to Tanka et al., in 2.2% cases the coeliac trunk and the superior mesenteric artery have a common origin (Tanka et al., 2013). The coeliac trunk was quadrifurcated in 5.2% patients in which pancreatic-duodenal artery or right inferior phrenic artery was fourth branch of the coeliac trunk. There were collaterals between coeliac trunk and superior mesenenteric artery in 7.5% patients (Tanka et al., 2013). In the present study CT was trifurcating in 41/42 cases, however in one case CT was quadrifurcating and middle colic artery was arising from coeliac trunk. Our case was not inconsistent with Adachi and Lipshutz classification, however in accordance to Uflaker classification which is type VII. On further exploration the middle colic artery gives an ancillary branch to the pancreas which is not reported in previous classifications. Thus the pancreas was supplied by middle colic artery as well as by pancreatic artery. According to Michel and Hiatt the hepatic arterial pattern is classified in 10 types (Hiatt et al., 1994) (Table 2). Michels's and Hiatt's did not tabulate all the anomalies of CT in their classifications, which varies from 1.4% to 1.8% which was documented by Koops et al., 2004 and Abdullah et al., 2006. In this study the left gastric artery gave an accessory branch which was bifurcating. The one branch was supplying to the left lobe of liver which was in accordance with Michel's and Hiatt's type 5 classifications. However another branch arose from an accessory artery which was supplying the cardiac end of stomach, is not mentioned in previous literature.

CONCLUSION

Familiarity with the arterial variants is of utmost importance for the successful implication of any abdominal surgery. The present study reveals variant pattern of arteries in the gastrointestinal tract; where the middle colic artery arose from the coeliac trunk and an accessory artery from left gastric artery. It enhances understanding towards clinical conditions like post prandial gastrointestinal colic pain, where there is relative sparing of transverse colon in cases with SMA stenosis. Complete acquaintance with arterial variations may prevent erroneous interpretation of angiograms. The topographical anatomy of such variations provides additional information which is of immense importance for interventional radiologists and surgeons. Normally coeliac trunk trifurcates into left gastric, splenic and common hepatic arteries. In the present study CT was quadrifurcating in which middle colic artery was arising from coeliac trunk. This middle colic artery gives an ancillary branch to the pancreas which is not reported in previous classifications. Thus the pancreas was supplied by branch from middle colic artery in addition to the pancreatic artery. In another case the left gastric artery gave an accessory branch which was bifurcating. The one branch was supplying to the left lobe of liver which was in accordance with Michel's and Hiatt's type 5 classifications. However another branch arose from an accessory artery which was supplying the cardiac end of stomach, is not mentioned in previous literature. Familiarity with the arterial variations is of importance for any abdominal surgery. The present study reveals variant pattern of arteries; where the middle colic artery arose from the CT and an accessory branch arose from left gastric artery. It enhances understanding towards clinical conditions like post prandial

gastrointestinal colic pain, where there is relative sparing of transverse colon in cases with SMA stenosis. Complete knowledge of these arterial variations may prevent erroneous interpretation of angiograms. Such variations provide additional information which is of immense importance for transplant surgeons.

Conflict of interest: None.

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