An unusual origin and branching pattern of accessory hepatic artery from celiac trunk in its significance in hepatobiliary surgeries

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Abstract

Introduction
Anatomical variations in the celiac trunk, hepatic artery and cystic artery are common. Knowledge of a rare variation in any of these arteries is required for surgeons and radiologists while planning any surgical or radiological intervention. This report describes a rare variant origin and course of an accessory hepatic artery arising from the celiac trunk, which was giving a cystic artery to gall bladder outside the Calot’s triangle.

Case report
The current report describes an unusual variation in branches of the celiac trunk as found during dissection of a 45 year old male cadaver in the Department of Anatomy, Maulana Azad Medical College, New Delhi, India. The celiac trunk gave an accessory hepatic artery apart from its usual three branches namely splenic artery, left gastric artery and common hepatic artery. The accessory hepatic artery supplied the right lobe of the liver and also provided a surgically relevant cystic artery outside the Calot’s triangle before entering the substance of the liver.

Conclusion
Surgeons and radiologist should be adept in managing the variant accessory hepatic artery arising from the celiac trunk supplying the gall bladder during interventions in the hepatobiliary region.

Introduction
The first visceral branch of the abdominal aorta, the celiac trunk (CT) usually trifurcates into the left gastric, splenic and common hepatic artery1.

In 75-90% of individuals it is 1.25cm long with variable length between 8-40mm2. Rare variations of the celiac trunk branching pattern as in uniting with the superior mesenteric artery to provide a common coeliacomesenteric trunk3,4,5, or giving off one or both inferior phrenic arteries6, or very rarely the origin of accessory hepatic arteries7,8,9 and cystic artery10 have been reported so far. However any accessory hepatic artery from the coeliac trunk giving origin to the only cystic artery coursing outside the Calot’s triangle is barely stated hitherto.

The cystic artery customarily originating from the right branch of the hepatic artery traverses the Calot’s triangle through its centre. The Variant Cystic artery originating from the Hepatic trunk, Left Hepatic, Gastroduodenal, Superior pancreaticoduodenal, right gastric, superior mesenteric artery and coeliac trunk have been described by various authors. A case of origin of the common trunk of the accessory hepatic artery (AHA) and cystic artery from the superior mesenteric artery was also identified11. The current case of an unusual course of the common trunk of AHA and CA originating from the Celiac trunk in the hepatoduodenal ligament of lesser omentum may pre-dispose it to unexpected bleeding or injuries during laparoscopic cholecystectomy.

In various cases variations of the visceral vascular branches to structures developing from foregut occur due to persistence of primitive blood supply from the abdominal aorta which undergo degeneration and form mature vasculature in the successive period12. Knowledge of these congenital anatomical variations of arterial supply to the gallbladder and liver is of importance in hepatobiliary surgical procedures. Hence, such a rare variable vascular pattern of an accessory hepatic artery originating from the celiac trunk and giving the cystic artery outside the Calot’s triangle must be considered. The aim of describing this variation is to understand rare occurring accessory hepatocystic trunk from the celiac trunk, which can be a guide and precaution during operative procedure in this region.

Case Report
The case report involved the dissection of a 45year old male cadaver of Indian origin using transperitoneal midline laparotomy during regular teaching of undergraduate medical students at Maulana Azad Medical College, New Delhi, India. An accessory right hepatic artery originating from the celiac trunk was observed. It then coursed superiorly and towards the right, further lying behind the portal vein and common bile duct in the free margin of lesser omentum. Subsequent trajectory depicted its location on the right side of the common bile duct and below the cystic duct before it entered the right lobe of the liver as an accessory hepatic artery. Just before entering the substance of the liver it gave a branch to the gall bladder which supplied it from the hepatic artery. The Calot’s triangle did not have any major blood vessel as its content. The common hepatic artery had its usual course and branching pattern except that none of its branches provided the cystic artery.

Discussion
The ambiguous celiac trunk anatomy due to persistent anastomotic channels is known to exist.

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Besides classical trifurcation of the celiac trunk, variations in its branching pattern have been studied. One or more of its components may arise from the aorta or at times the celiac trunk might be completely absent with all the components arising independently from the aorta. It has been reported that in 68% of cases other patterns of branching apart from trifurcation could be seen15, hence it is much more common to find variant branches from the celiac trunk. It becomes more crucial when one of the accessory branches arising from the celiac trunk is supplying the liver and gallbladder in combination. A commonly encountered celiac trunk variation in a systematic analysis was a hepatosplenic trunk with the left gastric and superior mesenteric artery originating separately13. According to textbooks, normal celiac trunk anatomy with typical arterial trunk giving rise to common hepatic, left gastric and splenic artery has a prevalence of 89%14.

Persistent anastomotic channels are reminiscent of the embryologic anastomosis between ventral splanchnic arteries15. Unusual origin of the common trunk of the accessory hepatic artery and cystic artery from the coeliac axis may be attributable to errors in complex developmental stages of vascular pattern. The hepatocystic bud arising from the junction of the foregut and midgut receives its rich supply from the aorta, coeliac axis and superior mesenteric artery. Later on an arterial rearrangement with persistence of some channels and specific reduction in others occurs, giving rise to adult pattern which could be either normal or may show a variable range of vascular patterns as observed16.

Arterial anomalies near the hepatobiliary region are an important consideration during laparoscopic or open cholecystectomy, with an accessory hepatic arterial anatomy and cystic artery variation being the most common. Accessory hepatic artery and replacing hepatic artery are the two types of aberrant hepatic arteries usually present. The aberrant artery supplying the liver in conjunction with the normal hepatic artery is defined as the accessory hepatic artery. An aberrant artery occurring as a substitute of the normal hepatic artery is termed as replacing hepatic artery17. The accessory hepatic artery reported in this case originating from the celiac trunk is unique because of its crucial branch to the gall bladder.

Origin, occurrence and importance of the accessory hepatic artery have been described previously,18 but its surgical importance when it is providing the cystic artery needs to be considered. The accessory hepatic artery previously reported by Shetty P et al. had its origin from the superior mesenteric artery and was also giving to the cystic artery11.

The cystic artery can have its variable origin from the right hepatic (75%), left hepatic (6 ± 2%), hepatic trunk (2 ± 2%), common hepatic (0 ± 6%), superior pancreaticoduodenal (0 ± 2%) and the superior mesenteric artery19. Various other reports in literature on similar variations in the cystic artery origin have been described20,21,22,23,24. When the cystic artery is lying outside the Calot’s triangle (13%) it could have its origin from the gastroduodenal, variant right hepatic artery, hepatic parenchyma or from the right hepatic artery25. Sacrificing the accessory right hepatic artery of small calibre during pancreaticoduodenectomy which impedes resection can have clinically significant consequences26.

Variations of the celiac trunk must be understood in anastomosing the proper arteries in the liver for a variety of liver surgeries including transplantation, tumour resection and laparoscopic hepatobiliary surgeries27. The reported incidence of conversion to open surgery because of blood vessel injuries is approximately 0%-1.9% during laparoscopic cholecystectomy28, and its mortality is about 0.02%-29. Safe laparoscopic cholecystectomy demands a good knowledge of the anatomy of the cystic artery and its variable origin.

Thus, many variations of this type should be identified and surgeons must be prepared to handle them. Preoperative imaging may depict aberrant vascular anatomy, hence

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variant anatomy must be discerned and described before surgical intervention.

**Conclusion**

The unusual origin of the common trunk of the accessory hepatic artery and cystic artery from the celiac trunk passing in the hepatoduodenal ligament and lying outside the Calot’s triangle should be considered in surgical procedures in the hepatobiliary region. Especially during laparoscopic or open cholecystectomy this variation should be remembered as inadvertent injury to these variable vessels might lead to excessive bleeding. To our knowledge, this variation has not been reported in the clinical literature. Knowledge of such a variation becomes important in patients undergoing any surgical or radiologic interventional procedures.

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Case report

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