Multiple variations of the hepatobiliary vasculature including a splenomesenteric trunk

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ABSTRACT

Anatomical variations of the origins and branching patterns of the hepatobiliary system may be encountered during both surgical and laparoscopic procedures. We report the rare finding of a splenomesenteric trunk with an absent coeliac trunk in a 74-year-old female cadaver. Due to the absence of the coeliac trunk, the common hepatic artery was found to originate from the splenic artery. Embryological considerations and possible clinical consequences are discussed.

Keywords: coeliac trunk, hepatobiliary system, splenomesenteric trunk, superior mesenteric artery

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INTRODUCTION

The splenic artery is considered the largest branch of the coeliac axis. It has a tortuous course, traversing from right to left along the superior margin of the pancreas.(1) The coeliac trunk is the first anterior branch arising inferior to the aortic hiatus. This trunk is approximately 1.5–2.0 cm in length and passes almost horizontally forward and slightly to the right, superior to the pancreas and splenic vein. Conventionally, the coeliac trunk gives rise to the left gastric, common hepatic and splenic arteries.(2) The variation "types" for the hepatobiliary pedicle and the branching patterns of the coeliac trunk are vast,(1-3) with many possible arrangements of these arteries regardless of the prevalence of such variations within a population. However, the splenic artery is less variable in comparison to the hepatic artery and the coeliac trunk.(4)

Furthermore, even fewer variations of the absent coeliac trunk have been described in the literature.(4) The splenic artery may arise from the aorta in combination with the hepatic artery to form a hepatosplenic trunk (3.5%), or combine with the left gastric artery to form a splenogastric trunk (5.5%).(4) Knowledge of these variations is necessary in order to avoid surgical injury and improper interpretation of imagings. We present a case of an anomalous splenic artery which arose as a branch of the superior mesenteric artery and gave rise to the common hepatic artery.

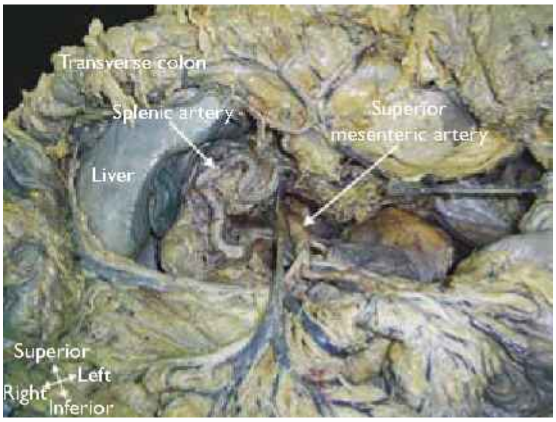

Fig. 1 Photograph shows a specimen in which the greater curvature of the stomach and the pancreas are reflected superiorly in order to expose the course of the splenic arterial ring from the superior mesenteric artery towards the spleen.

CASE REPORT

While performing a routine anatomical dissection of a female cadaver, a 74-year-old woman who had died of congestive heart failure, multiple anatomical variations of the hepatobiliary arterial system were found. No other variations or anomalies were noted.

The liver in this specimen received a proper hepatic artery originating from the common hepatic artery. The coeliac trunk was absent and the splenic artery gave rise to the common hepatic artery (Fig. 1). Branching from the descending aorta, the superior mesenteric artery gave rise to the splenic artery, which curved inferior to the head of the pancreas to the right and superior to the hepatobiliary triangle. This large arterial loop replaced the coeliac trunk, the hepatic artery proper and the gastroduodenal artery, and ended in the spleen. In addition, this vessel was tortuous, as seen in a typical splenic artery.

DISCUSSION

A review of the literature revealed very few references pertaining to the common hepatic artery and its origin from a splenic artery, which in turn originates from the superior mesenteric artery. The splenic artery, in

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our case, curved inferior to the head of the pancreas to the right and superior to the hepatobiliary triangle. A similar case where an arterial loop was formed around the hepatobiliary triangle between the coeliac trunk and the gastroduodenal artery has been published by Loukas and Jordon[5] In addition, Hirai et al presented a similar branching pattern for the common hepatic, splenic and superior mesenteric arteries; however, it differed from our case in the origin of the gastric arteries.[4] In the present case, the arterial loop created by the splenic artery near the hepatobiliary triangle may have implications for surgeons and may complicate an otherwise normal laparoscopic cholecystectomy.

According to Bergman et al, the splenic artery originates from the aorta in the following manner: the coeliac trunk with hepatosplenogastric branches (90%), the hepatosplenic trunk (3.5%), the splenogastric trunk (5.5%), the coeliacomesenteric trunk; and the superior mesenteric in conjunction with the hepatosplenogastric trunk (1%–2.5%). They also reported a splenic artery originating from the superior mesenteric artery in only 0.5% of the population,[4] but to the best of our knowledge, a common hepatic artery originating from the splenic artery, as in our case, is extremely rare.

The coeliac trunk, in what is considered a normal anatomy, gives rise to the arterial branches which supply the stomach, liver, pancreas, duodenum and spleen. Michels described the variations of the coeliac and the hepatic arterial branches by classifying them into eight types.[6] In Type II, the replaced left hepatic artery arises from the left gastric artery, while the coeliac trunk supplies only the right and middle hepatic arteries. A different classification scheme involving ten classification types has been proposed by Kitamura et al, and quoted by Lippert and Pabst.[7] According to this system, a lienohepatic trunk arises from the aorta and gives rise to only the splenic and proper hepatic arteries, in which the left gastric artery arises independently from the aorta; a variation which they reported as occurring in 3.5% of the specimens.[7] The most complicated scheme was offered by Adachi, who described six types along with 28 subtypes, none of which corresponds with our case.[8] However, this classification differs from our case in the origin of the gastric and inferior phrenic arteries. Despite several large studies on the variations of the hepatobiliary and gastric vasculatures, to the best of our knowledge, the combination of arterial variations presented in this case has not been reported in the literature.

Clinically, laparoscopic cholecystectomy has almost completely replaced open cholecystectomy. Therefore, it is important for every laparoscopic surgeon to be familiar with the variations in the anatomical features of the extrahepatic biliary tree and those of the arterial supply of the gallbladder. Anatomic relations appear differently on laparoscopic visualisations, thereby increasing the risk of intraoperative injury to vital vasculatures and the biliary structures. In this case, the loop created by the splenic artery near the hepatobiliary triangle, along with the splenic artery giving origin to a common hepatic artery, becomes important since the anatomical spatial relations would be altered from what is considered normal, and thus possibly changing the spatial location of the cystic artery. In trying to identify the Calot's triangle, otherwise known as the hepatobiliary triangle, this is the first structure encountered, and therefore, there exists an increased risk of transecting the artery upon dissection near the infundibulum of the gallbladder. Since in this case, the origin of the common hepatic artery was altered from the normal, this may distort the spatial course of the cystic artery further down the arterial tree.

Another clinical possibility would be an aneurysm of the splenic artery as it originates from a splenomesenteric trunk. Aneurysms of the splenic artery are rare lesions, whose reported incidence varies from 0.098% in a study of 195,000 autopsies to 10.4% in a study on cadavers searched systematically for splanchnic vessel aneurysms. In general, the incidence is estimated to be around 0.8%.[9] This is rare, however, as symptoms, such as epigastric pain, may appear if the aneurysm compresses the surrounding structures. It is found to be more prevalent in women, and the cause is assumed to be congenital. To date, there are nine reports in the literature of splenic artery aneurysms arising from the splenomesenteric trunk.[10] Tochii et al described an asymptomatic patient with a splenic artery aneurysm (at its proximal portion) arising from a splenomesenteric trunk.[11] In this case, an incision of the gastrocolic ligament and the transverse mesocolon was performed. The treatment of the splenic artery aneurysm depends on its location in the splenic artery. In addition, an open procedure is preferred to a transcatheter coil embolisation, stent graft repair or laparoscopic resection.[10] Settembrini et al described two young patients who had 4 cm aneurysms behind the pancreas that involved an anomalous splenic artery. The first patient required dissection of the entire splenopancreatic block through a transverse abdominal incision to excise the aneurysm and repair the superior mesenteric artery. The second patient was treated by the classic approach; through a median incision and by entering the mesenteric root.[12] Lastly, Sato et al described a case of successful treatment by transcatheter embolisation of the splenomesenteric trunk using detachable coils.[13]

There are many complications associated with laparoscopic cholecystectomy. 85% of bile duct anomalies have been identified in the Calot's triangle.[14] Additionally, there may be arterial anastomotic communications between the cystic artery and the arterial system of the liver that need to be considered. Chen et al evaluated their experience with over 2,000 cholecystectomies and concluded that depending on the position of the cystic artery in relation to other structures around it, the laparoscopic approach to a cholecystectomy would change.[15]

Embryologically, the simple arboriform scheme of the gastroduodenal and hepatobiliary vasculature is profoundly altered by the growth of the liver and pancreas, and by the assumption of a curved form in the stomach and duodenum. These factors operate to complicate the branching of the coeliac axis and the proximal segment of the superior mesenteric artery. Considering that the liver is derived from a portion of the primitive duct supplied primordially by the coeliac and mesenteric arteries, it may receive the rami from both of these sources. The same is true for the gallbladder. Considering the complexity of this developmental scheme, it is easy to understand the large degree of arterial variations within this vascular system. More than 50 years ago, it was stated that "cholecystectomy is a dangerous operation unless one realises that variations are very common."[14] Since that time, anatomical reports of variations in the hepatobiliary and gastric vasculatures, in addition to improvements in surgical techniques and advancements in technology, have removed many of the dangers previously associated with these now-common procedures.

Knowledge of the different anatomical variations of the arterial supply of the gallbladder, liver and stomach is of great importance in cholecystectomy, hepatobiliary and gastric surgical procedures.[16]

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