

An anatomical variation in the branching pattern of the coeliac trunk

Anita Mahajan¹, Shipra Paul², Srijit Das³

¹Department of Anatomy, Maulana Azad Medical College, New Delhi, India

²Lady Harding Medical College, New Delhi, India

³Universiti Kebangsaan Malaysia, Kuala Lumpur, Malaysia

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Corresponding author:

Prof. Dr. Shipra Paul
D-II/ A-75, Nanak Pura
Moti Bagh South
New Delhi-110021, India
Phone: 0091-11-26119751
E-mail: drshipra14@yahoo.com

Abstract

The coeliac trunk gives off three branches, i.e. the splenic artery, the hepatic artery and the left gastric artery. In the present study, we report two additional branches arising from the coeliac trunk. Of the two branches, the larger branch (accessory hepatic artery) traversed to the right, passing posterior to the portal vein, thereby ascending along the left margin of the common bile duct, while the smaller branch supplied the common bile duct (retroportal artery). Anatomical knowledge of the anomalous branching pattern of the coeliac trunk may be important for surgical, interventional and radiological purposes.

Key words: anomalous, coeliac trunk, branches, accessory, retroportal.

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 [1]. 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]. A vessel which supplies a lobe in addition to its normal vessel is defined as an accessory artery and a replaced right hepatic artery or an accessory hepatic artery is defined as one which arises from the superior mesenteric artery [1]. Rarely accessory, left or right hepatic arteries may also arise from the gastroduodenal artery or the aorta.

Considering the above definitions, we report a case where two additional arteries were observed to originate from the coeliac trunk. A larger branch, originating from the coeliac trunk, took a horizontal course posterior to the portal vein and then traversed upwards to enter the right lobe of the liver after traversing the Calot's triangle. This artery, which supplied the right lobe in addition to the usual right hepatic artery, could thus be termed an accessory hepatic artery (AHA). A smaller branch running parallel and inferior to AHA participated in the arterial anastomosis around the common bile duct. This artery may be termed the retroportal artery (RPA), which originates from the superior mesenteric artery in 58.3% of cases and in 41.7% from the coeliac trunk [2].

Additional branches other than the normal branches are referred to as collaterals [3]. It is an accepted fact that variations of the coeliac trunk

do frequently exist and thus its presence may not be undermined. The aim of the present study was to highlight the additional branches arising from the coeliac trunk and discuss their topography, which may be important for surgeons operating in the upper abdominal and hepatobiliary regions. Presence of additional arteries may provide collateral circulation which may be important during transplant surgeries. Knowledge of anomalous branches of the coeliac trunk may also be important for interventional radiologists in day-to-day clinical practice.

Case report

During routine cadaveric dissection for undergraduate medical students in the department of anatomy, Maulana Azad Medical College, we observed anomalous branching pattern of the coeliac trunk in a 55-year-old male who died following a road traffic accident. The coeliac trunk and its branchings were carefully dissected and the surrounding structures were delineated. Morphometric measurements were taken and appropriate photographs were taken (Figure 1).

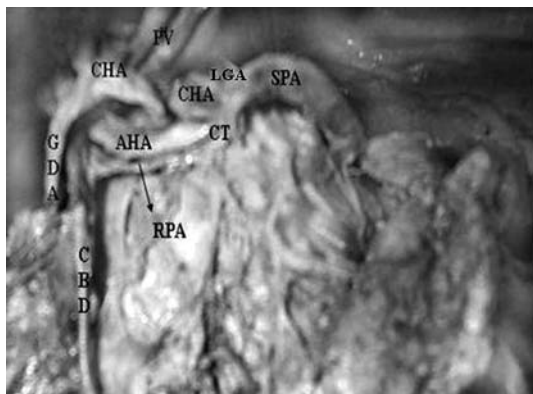
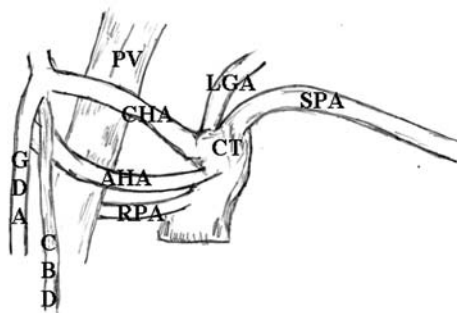


Figure 1. Photograph of dissected specimen showing: CT – coeliac trunk, LGA – left gastric artery, SPA – splenic artery, CHA – common hepatic artery, GDA – gastroduodenal artery, CBD – common bile duct, RPA – retroportal artery, PV – portal vein cut and reflected upwards, AHA – accessory hepatic artery



Line diagram resembling photograph in Figure 1. All legends are as mentioned in Figure 1

The coeliac trunk ('CT' in Figure 1) originated from the abdominal aorta. At a distance of 0.5 cm from its origin from the coeliac trunk, divided into the three usual branches, i.e. the common hepatic artery ('CHA' in Figure 1), the splenic artery ('SPA' in Figure 1) and the left gastric artery ('LGA' in Figure 1). Two additional branches were observed just inferior to the origin of the common hepatic artery. These branches were: (1) a large branch, i.e. an accessory hepatic artery (AHA in Figure 1) to the right lobe of the liver, (2) a small retroportal branch. The AHA measured 3.8 mm in its length from its origin to its entry into the porta hepatis. The AHA traversed a course to the right. The AHA then ascended along the left margin of the common bile duct (CBD), passing posteriorly to it, and then entered into the right lobe of the liver. The common hepatic artery passed anteriorly and to the left of the portal vein. Thus the portal vein was found to lie in between the common hepatic artery and the AHA, near the porta hepatis. Thus the right lobe of the liver received blood supply from the normal right hepatic artery, as well as the AHA. The cystic artery was found to arise from the right hepatic artery and showed a normal branching pattern.

The RPA ('RPA' in Figure 1) traversed a horizontal course to the right side posterior to the portal vein and participated in the arterial anastomosis around the CBD. No other anomalies related to branching pattern of the hepatic, splenic or the left gastric artery were observed.

Discussion

The coeliac trunk is known to exhibit variations. Variations of the hepatic artery and the coeliac trunk are present in 55% of individuals [4]. Considering these facts, the presence of such an additional branching pattern of the coeliac trunk cannot be overlooked.

The co-existence of a bigger AHA and smaller retroportal branch supplying the common bile duct, as observed in the present case, are rare finding. A retroportal artery may arise from the coeliac axis, superior mesenteric artery or one of its major branches. Such a retroportal artery traverses a course posterior to the portal vein and ends by joining the retroduodenal artery or the right hepatic artery, thereby completing the arterial network. Anastomoses of the arteries may play an important role in blood circulation.

During surgery related to the biliary system, there may be inadvertent injury to this artery closely related to the bile duct. Often during surgery of the bile duct involving a longer length, knowledge of the anatomy of the arterial network around the duct is important to check any occlusion of the blood vessel which may eventually lead to necrosis.

The developmental reasons for the presence of such additional arteries may be explained as any defect occurring in the longitudinal anastomosis between the four roots of the omphalomesenteric artery [5]. It is considered that three roots, i.e. the hepatic, splenic and left gastric arteries, originate at this longitudinal anastomosis and this gets separated from the fourth root, which is the future superior mesenteric artery [5]. Any extra root may result in an additional branch from the coeliac trunk.

An aberrant hepatic artery is defined as one which arises other than from a typical common hepatic artery. Aberrant hepatic arteries are of two types, i.e. replaced (considered as a substituted vessel) and accessory (considered as an additive vessel) [6]. A replaced right hepatic artery or an AHA has been reported to originate from the superior mesenteric artery, thereby traversing a route posterior to the portal vein and the cystic duct [6]. In the present case, the AHA was the additional artery to the right lobe but it originated directly from the coeliac trunk, which is a rare finding.

Anatomical knowledge of the coelico-mesenteric arterial branches is clinically important when performing pancreaticoduodenectomy. During split-liver transplantations, anatomical knowledge of the variations is essential to ensure complete vascular and biliary supply to both grafts [7]. The same study clearly mentioned that even though modern day techniques such as visceral angiography, DCEMRI and spiral CT are commonly used for preoperative evaluation of patients suspected of periampullary tumours, a thorough knowledge of arterial anatomy may be beneficial [7]. Surgeons performing ligations of AHA should be aware of such variations. Wrong manipulations may cause bleeding during surgery, ischaemia and necrosis.

Recent studies have stressed the fact that 64-row CTA enables visualization of small vessels and accessory arteries which are difficult to identify using other techniques [8]. The high sensitivity of 64-row CTA even detects minor vascular anomalies which are unreported in the literature [8]. Various anatomical variations in the extrahepatic biliary tree have been described. The commonest type of distribution, known as the 'axial' model, involving two vascular sources, i.e. right hepatic and cystic above and superior pancreaticoduodenal below, has been described [9].

Abnormal course and variation of any of the branches of the coeliac trunk may result in altered blood flow and thereby predispose to aneurysm. Often, the branches of the coeliac trunk may have to be reconstructed to provide an anastomosis to the donor recipient. Surgeons are exposed to the vagaries of the coeliac trunk during such procedures.

In conclusion, hepatic intra-arterial anatomy is important for proper pre-operative diagnosis and planning. Presence of arterial variations may result in erroneous interpretation of angiograms. The topographical anatomy of such variations is also important for interventional radiologists performing arteriography. It has also been found that the arteries may be a site for infective organisms which may predispose to atherosclerosis [10]; thus its importance may not be taken lightly. We as anatomists opine that the presence of AHA is extremely important for surgeons, radiologists and clinicians in their clinical practice.

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