Clinically relevant variations of the coeliac trunk

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ABSTRACT

Introduction: Vascular patterns are important in the planning and performance of all upper abdominal surgical procedures. The coeliac trunk arises from the abdominal aorta and supplies the supracolic organs. Knowledge of variations of the coeliac trunk is important in procedures such as liver transplants for appropriate vascular ligation and anastomosis.

Methods: The branching patterns of the coeliac trunk of 50 cadavers (40 male, 10 female) were recorded and analysed during routine dissection by undergraduate students from the Department of Anatomy, NRI Medical College and Siddhartha Medical College, India, from 2003 to 2008. Observations on clinically important variations of the coeliac trunk were noted.

Results: The patterns of branching of the coeliac trunk were observed to vary from classical trifurcation to abnormal trifurcation, bifurcation, quadrifurcation, pentafurcation and even hexafurcation of the trunk. The additional branches of the trunk included the inferior phrenic artery, gastroduodenal artery, middle colic artery, dorsal pancreatic artery, jejunal or duodenal branch. Clinically relevant variations of the coeliac trunk were noted in many cases.

Conclusion: Variations of the coeliac trunk must be carefully understood in anastomosing the proper arteries in liver transplant surgeries. Knowledge of the variations of the branches of the coeliac trunk, such as the left gastric artery, gastroduodenal artery and middle colic artery, is important when performing surgery of the stomach, duodenum and pancreas.

Keywords: bifurcation, coeliac trunk, hexafurcation, pentafurcation, quadrifurcation, trifurcation

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INTRODUCTION

The most common classical type of coeliac trunk is known as trifurcation and was first observed by Haller as tripus Halleri.[1] It was, and still is, considered to be the normal appearance of a coeliac trunk. According to Haller, the coeliac trunk is divided into the common hepatic artery, splenic artery and left gastric artery, which usually arises as a tributary elsewhere in this trunk, while the other divisions of the coeliac trunk rarely occur in the human population.[1] Anatomical variations of the coeliac trunk were first classified by Adachi in 1928, based on 252 dissections of Japanese cadavers, where six types of divisions of the coeliac trunk and superior mesenteric artery were described.[2]

METHODS

During routine educational dissections among undergraduate students from 2003 to 2008 at the Department of Anatomy, NRI Medical College and Siddhartha Medical College, India, the branching patterns of the coeliac trunk in 50 cadavers of both genders (40 male, 10 female) were analysed and recorded. Clinically important variations of the coeliac trunk were also observed.

RESULTS

The trifurcation of the coeliac trunk into the usual three branches, the left gastric artery, common hepatic artery and splenic artery, was observed in only 20 cadavers in the present study. The trunk divided into two branches; the hepatosplenic trunk in one specimen (Case 1) and the gastrosplenic trunk in two specimens (Case 2). The trunk divided into four branches: the inferior phrenic artery, either one-sided or on the common trunk of both sides, in ten cadavers, or the additional branch was the gastroduodenal artery in one specimen (Case 3), or the middle colic artery in two cadavers (Case 4), or the duodenal or the pancreatic branches in five cadavers. The left hepatic artery arising from the left gastric artery was observed in seven specimens (Case 5) in the present study. The five branches of the coeliac trunk included the inferior phrenic and middle colic artery in one cadaver. The six branches of the coeliac trunk also included the duodenal branch in addition to the abovementioned branches.

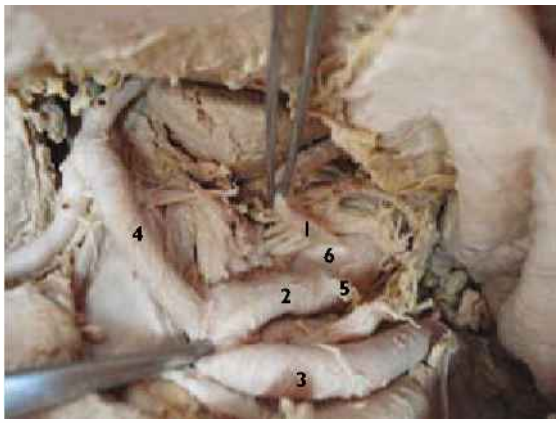

Fig. 1 Photograph shows hepatosplenic trunk and splenic artery arising directly from the aorta.
1: left gastric artery; 2: hepatosplenic trunk; 3: splenic artery; 4: common splenic artery; 4: cut end of trunk of inferior phrenic arteries; 6: aorta

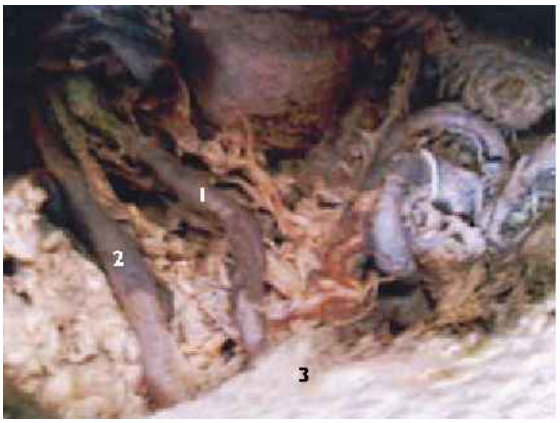

Fig. 2 Photograph shows the origin of both the right and left hepatic arteries from the superior mesenteric artery in a case of a gastrosplenic trunk.
1: left hepatic artery; 2: right hepatic artery; 3: superior mesenteric artery

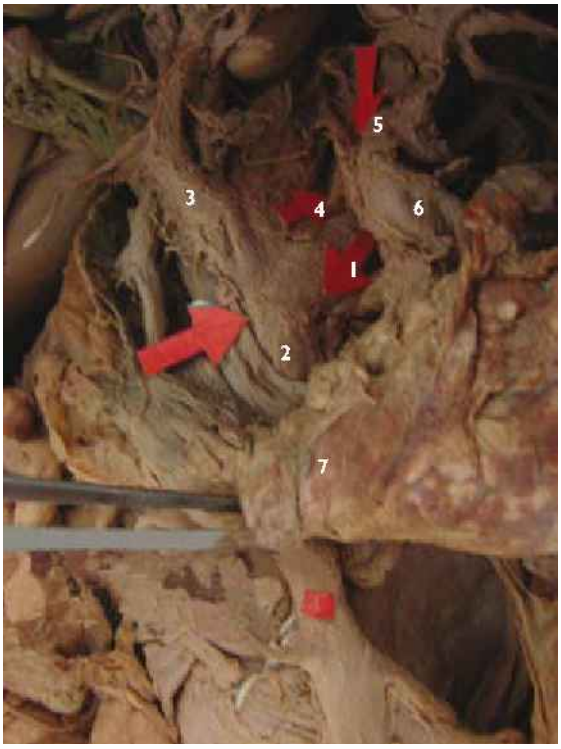

Fig. 3 Photograph shows the origin of a common hepatic artery from the superior mesenteric artery – hepatomesenteric trunk.
1: hepatomesenteric trunk; 2: superior mesenteric artery; 3: common hepatic artery; 4: gastrosplenic trunk; 5: left gastric artery; 6: splenic artery; 7: pancreas

Fig. 4 Photograph shows the origin of a gastroduodenal artery from the coeliac trunk.
1: coeliac trunk; 2: splenic artery; 3: left gastric artery; 4: common hepatic artery; 5: gastroduodenal artery; 6: pancreas

The clinically relevant variations of the coeliac trunk were as follows:

Case 1: The coeliac trunk bifurcated into the common hepatic artery and splenic artery in a male cadaver, and the left gastric artery arose as a separate branch of the abdominal aorta just proximal to the origin of the coeliac trunk. The common trunk of the inferior phrenic arteries on both sides arose from the hepatosplenic trunk (Fig. 1).

Case 2: The coeliac trunk bifurcated into a gastrosplenic trunk in two male cadavers. In one, the right and left hepatic arteries originated separately from the superior mesenteric artery (Fig. 2), and in the other, the common hepatic artery arose as a common trunk with the superior mesenteric artery – the hepatomesenteric trunk (Fig. 3).

Case 3: In a female cadaver, the coeliac trunk divided

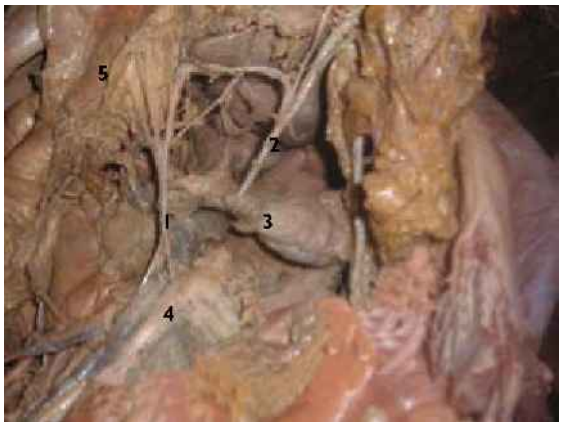

Fig. 5 Photograph shows double middle colic arteries – a middle colic artery from the superior mesenteric artery and another from the coeliac trunk.
1: middle colic artery from the superior mesenteric artery; 2: middle colic artery from the coeliac trunk; 3: body of the pancreas; 4: superior mesenteric artery; 5: transverse colon

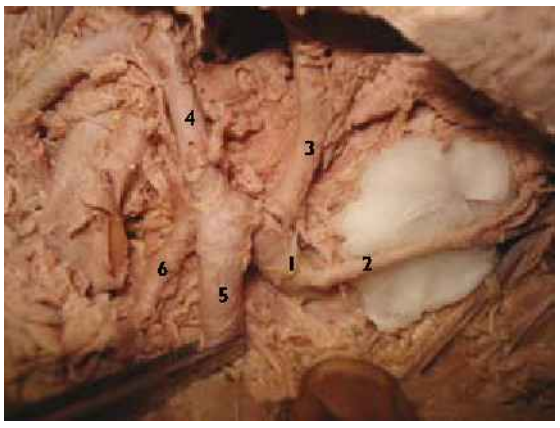

Fig. 6 Photograph shows the pentafurcation of the coeliac trunk – a middle colic artery and right inferior phrenic artery with additional branches of the coeliac trunk.
1: coeliac trunk; 2: right inferior phreic artery; 3: left gastric artery; 4: common hepatic artery; 5: splenic artery; 6: middle colic artery

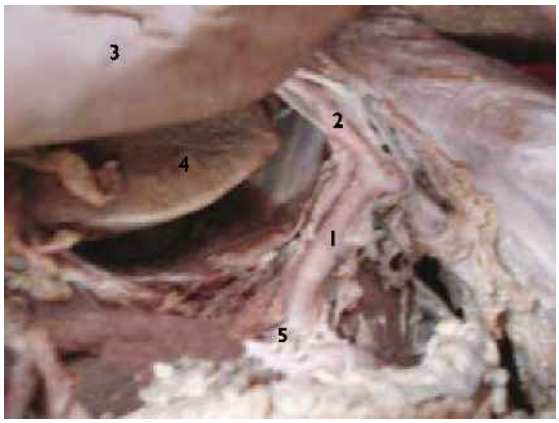

Fig. 7 Photograph shows the origin of the left hepatic artery from the left gastric artery.
1: left gastric artery; 2: aberrant left hepatic artery; 3: left lobe of the liver; 4: caudate lobe; 5: coeliac trunk

into four branches; the gastroduodenal artery in addition to the normal branches (Fig. 4). The gastroduodenal artery, which ran above the upper border of the head of the pancreas, divided into the right gastroepiploic and superior pancreaticoduodenal arteries.

Case 4: In a male cadaver, the coeliac trunk divided into four branches; the middle colic artery apart from the normal branches of the trunk. The middle colic artery also arose from the superior mesenteric artery in this specimen (the double middle colic arteries in this case) (Fig. 5). In another male cadaver, the middle colic artery and right inferior phrenic artery were the additional branches of the trunk; pentafurcation of the coeliac trunk (Fig. 6).

Case 5: The left hepatic artery arose as the branch of the left gastric artery in seven cases (Fig. 7), and in five of these cases, the left hepatic artery was replacing in nature, while in the other two, the left hepatic artery was accessory in nature, in addition to the normal origin of the left hepatic artery from the common hepatic artery. There were three accessory left hepatic arteries in one specimen.

DISCUSSION

Adachi and Michels have classified the coeliac trunk into six different types.[2,3] The types of coeliac trunk according to Michels' classification[3] are as follows: Type 1: normal branching; Type 2: hepatosplenic trunk and left gastric artery from aorta; Type 3: hepatosplenomesentric trunk and left gastric from aorta; Type 4: hepatogastric trunk and splenic artery from superior mesenteric artery; Type 5: splenogastric type; splenic and left gastric from the coeliac trunk and common hepatic artery from superior mesenteric artery; and Type 6: Coeliacomesentric trunk; splenic, left gastric, common hepatic and superior mesenteric arteries arise from a common trunk.

The classifications created by Adachi and Michels are somewhat similar for Type 1 to 3, but the other types differ.[2,3] The incidence of hepatosplenic trunk was 2% and that of gastrosplenic trunk was 4%, while the incidence of hepatomesenteric trunk was 2% in the present study. The same types were observed as 8%, 3% and 0.5%, respectively, in the study conducted by Adachi.[2] The hepatosplenic trunk and separate left gastric artery from the aorta and the accessory left hepatic artery from the left gastric artery in a cadaver have been reported by Loukas et al.[4] An anomalous hepatic arterial anatomy causing the traumatic false aneurysm of the left gastric artery has been described by Allorto et

al.[5] The incidences of the various types of coeliac trunk found in different studies have been provided by Branco via Poynter.[6] Coeliac artery compression syndrome has been studied in detail by Loukas et al.[7]

According to Bergman et al, the trunk may have more than three branches.[8] The incidence of gastroduodenal artery arising from the coeliac trunk was 2% in the present study. Daseler et al quoted the incidence of the gastroduodenal artery from the coeliac trunk as 0.4% in their study.[9]

Middle colic arteries have been found to originate from the coeliac trunk at a rate of 0.5%–1%.[10,11] The incidence of a middle colic artery arising from the coeliac trunk in the present study was 4%. A middle colic artery originating from a coeliac trunk is considered as evidence for the ventral longitudinal anastomosis of the primitive vitelline arteries in the embryo. An anomalous middle colic artery originating from the common hepatic artery has been reported by Wadhwa et al.[12] Garcia-Ruiz et al reported the presence of double middle colic arteries in their study of cadaveric dissections.[13] Inferior phrenic arteries arose from the coeliac trunk at a rate of 40% in the study by Loukas et al.[14] A case wherein the coeliac trunk acted as the origin of an accessory renal artery, two testicular arteries, middle suprarenal and left inferior phrenic arteries has been reported by Deepthinath et al.[15]

Michels described the hepatic arterial anatomy and its variations using the results of cadaveric dissection and identified nine types of hepatic arterial anatomy, namely, Type I: normal pattern; Type II: a replaced left hepatic artery from the left gastric artery; Type III: a replaced right hepatic artery from the superior mesenteric artery; Type IV: replaced right and left hepatic arteries; Type V: an accessory left hepatic artery; Type VI: an accessory right hepatic artery; Type VII: accessory right and left hepatic arteries; Type VIII: a replaced right or left hepatic artery with the other hepatic artery being an accessory artery; and Type IX: the hepatic trunk acting as a branch of the superior mesenteric artery.[3] In the present study, apart from Types I and II, other types, such as Types IV, V, VI and IX, were also observed.

This study has demonstrated variations in the anatomy of the coeliac trunk in nearly 60% of its specimens. Rawat has demonstrated that computerised tomographic angiography can better reveal the vascular variations of the upper abdomen.[16] Preoperative knowledge of the variations of the coeliac trunk and its branches is essential for surgeons, particularly in the present era of minimal access surgeries.

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