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Research Article

Celiac trunk variations – anatomy and clinical relevance

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Abstract

Introduction: Variability in the branching of the visceral arteries of the abdominal aorta is not uncommon. The typical celiac trunk is found in 65% to 90% of the individuals. Knowing and classifying the anatomical variations in the celiac trunk are necessary due to their impact on various clinical cases.

Aim: The aim of the study was to explore the anatomical variations of the celiac trunk in cadaver dissections.

Materials and methods: This study was conducted in the Department of Anatomy, Histology, and Embryology of the Medical University of Plovdiv. The celiac trunk was examined during student dissection of 18 adult formalin-fixed cadavers (9 males and 9 females).

Results: In 72.2% of the examined cadavers, a celiac trunk with the typical three arterial branches—left gastric, splenic, and common hepatic arteries—was identified. A branching pattern of the celiac trunk with two arterial branches—the left gastric artery and the hepatosplenic trunk—was found in three (16.6%) of the cadavers that were examined. A celiac trunk branching into hepatomesenteric and gastrosplenic trunks was observed in one cadaver (5.6%). A branching pattern of the celiac trunk with four arterial branches, including a fourth branch supplying the pancreas, was found in one cadaver (5.6%).

Conclusions: The results of the study demonstrate that there are anatomical variations that need to be taken into account when planning and carrying out abdominal surgery procedures.

Keywords

coeliac trunk, human cadavers, splenic artery

Introduction

The celiac trunk is the first visceral unpaired branch of the abdominal aorta. The origin of this structure is located at the anterior aspect of the abdominal aorta, specifically at the level of the 12th thoracic vertebra. In a short distance (1-2 cm), the coeliac trunk divides into three branches: the left gastric artery (LGA), the splenic artery (SA), and the common hepatic artery (CHA).[1] However, the branching pattern of the coeliac trunk is often variable, with the typical coeliac trunk being present in 65% to 90% of individuals.

An absent celiac trunk, in which its three arterial branches originate from the abdominal aorta, has been documented by Covantsev et al.[2] and Bezabih[3]. The prevalence of this anomaly is exceedingly low, with estimated rates of 0.6% by Iezzi et al.[4] and 2.6% by Venieratos et al[5].

According to Srimani and Saha[6] the SA is present in most cases, while the LGA and CHA are more commonly variable. Their findings indicate that the classical trifurcation is present in 65.52% of cases, while various types of bifurcation refer to 12.07% and tetrafurcation to 22.41%.

Considering the images of 5002 patients, Song et al.[7]

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proposed a model for the synthesis of the available data on the celiac trunk variations. According to the authors, normal truncus anatomy is present in 89.1% of cases, while variations occur in 9.6%. An understanding of these variations is fundamental for the successful planning and performance of surgical procedures in the supracolic region of the peritoneal cavity.

Aim

The aim of this study was to explore the anatomical pattern of the celiac trunk in cadaver dissections.

Materials and methods

The study was conducted in the Department of Anatomy, Histology, and Embryology of the Medical University of Plovdiv. The celiac trunk was examined during student dissection of 18 adult formalin-fixed cadavers (9 males and 9 females). The department received the dissected cadavers as a donation for student education.

Results

The results are presented in **Table 1**.

A typical celiac trunk with three branches—LGA, SA, and CHA—was identified in 72.2% of the examined cadavers (6 males and 7 females) **(Fig. 1)**.

In three (16.6%) of the examined cadavers (two males and one female), a celiac trunk pattern was identified with two arterial branches—a hepatosplenic trunk (HST) and LGA **(Fig. 2)**. In one female cadaver (5.6%), a celiac trunk with two branches—hepatomesenteric trunk (HMT) and gastrosplenic trunk (GST)—was observed **(Fig. 3)**. In one male cadaver (5.6%), a celiac trunk pattern was identified with four arterial branches, including a fourth branch, the accessory pancreatic artery (APA), supplying the pancreas **(Fig. 4)**.

Table 1. Anatomical variations identified in present study

Celiac trunk - types	n (%)
Trifurcation (Haller's tripod - LGA+CHA+SA)	13 (72.2%)
Bifurcation (HST+LGA)	3 (16.6%)
Bifurcation (HMT+GST)	1 (5.6%)
Tetrafurcation (LGA+CHA+SA+APA)	1 (5.6%)

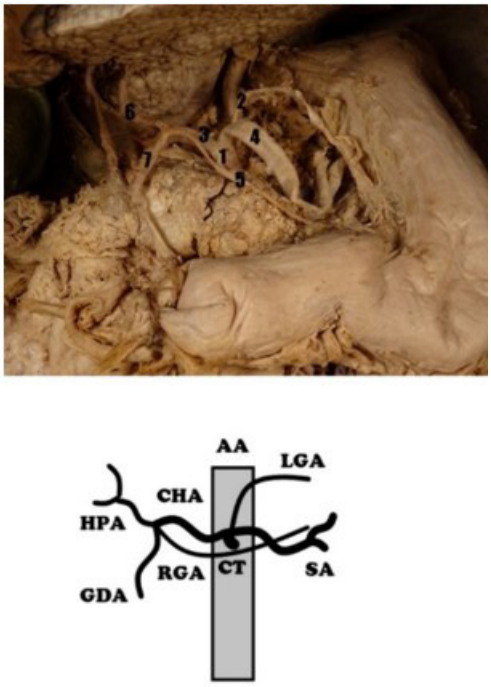

Figure 1. Abdominal aorta (AA), celiac trunk (1, CT), left gastric artery (2, LGA), common hepatic artery (3, CHA), splenic artery (4, SA), right gastric artery (5, RGA), proper hepatic artery (6, PHA), gastroduodenal artery (7, GDA).

Discussion

The authors studying the anatomical patterns of the celiac trunk reported that the classical type with three arterial branches occurs in 90%[8], 82.02%[9], and 89%[10] of the cases. According to Vougadiotis et al.[11], a true tripod was present in 74.0% of the examined cadavers. This finding agrees with our results, according to which the celiac trunk with three main branches, LGA, CHA, and SA, was present in 72.2%. As outlined by Vougadiotis et al.[11], the most prevalent variations can be categorized into three categories: the HST, in which the LGA arises from the abdominal aorta; the HST, in which the LGA originates from the SA; and the hepatogastric trunk (HGT) and SA, which arise from the superior mesenteric artery. In 16.6% of the cadavers examined in this study, a celiac trunk pattern with two arterial branches, the HST and LGA, was identified. In a routine dissection, Demirtas et al.[12] observed that the celiac trunk emerges with two roots, HGT and HST. Araujo Neto et al.[8] found the presence of an HST in 8.3% and HGT in 1.7%. In their study, Tang et al.[13] proposed a classification of the celiomesenteric trunk (CMT) into five types based on 5580 computed tomography angiography scans—type I HGSM, type II HSM and LGA, type III GSM and CHA, type IV HGM and SA, and type V other types of variation. The hepatomesenteric trunk (HMT) and LGA variation identified in our study was classified as one of the subvariants of type V, with the authors noting that type V CMT occurred in 4.44% of cases. Cases have been reported in the literature in which the celiac trunk with three branches is absent, and HMT and HST have been observed to arise independently from the abdominal aorta.[14-16] Bhatnagar S et al.[17] reported CMT split into a celiac trunk and superior mesenteric

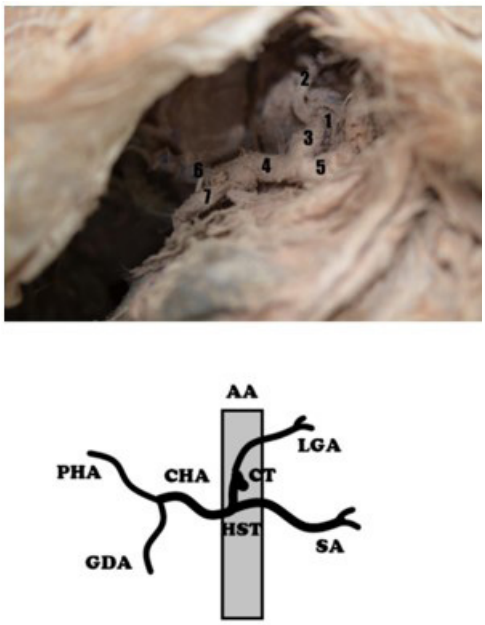

Figure 2. Abdominal aorta (AA), celiac trunk (1, CT), left gastric artery (2, LGA), hepatosplenic trunk (3, HST), common hepatic artery (4, CHA), splenic artery (5, SA), proper hepatic artery (6, PHA), gastroduodenal artery (7, GDA).

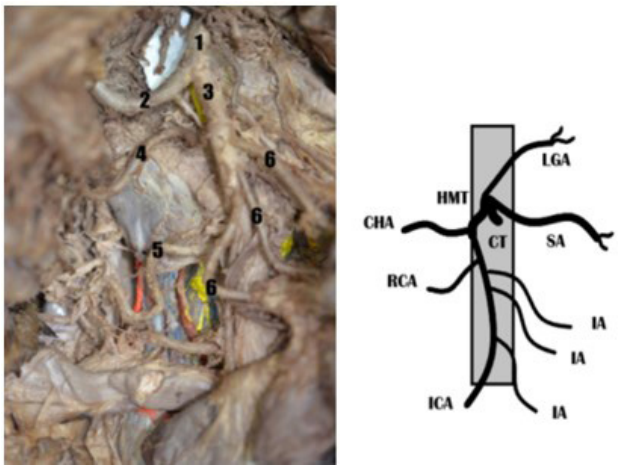

Figure 3. Abdominal aorta (AA), celiac trunk (CT), hepatomesenteric trunk (1, HMT), common hepatic artery (2, CHA), superior mesenteric artery (3, SMA), right colic artery (4, RCA), ileocolic artery (5, ICA), intestinal arteries (6, IA).

artery found on computed tomography in a 44-year-old man. Zagyapan et al.[18] observed that the CHA originated from the superior mesenteric artery in 6.6% of the studied individuals, and Chen et al.[19] reported that the CHA arose from the superior mesenteric artery in 3.5%.

A celiac trunk pattern with four arterial branches, including a fourth branch supplying the pancreas, was identified in one female cadaver (5.6%). According to Venieratos et al.[5] the celiac trunk presented additional fourth branches in 5.2%.

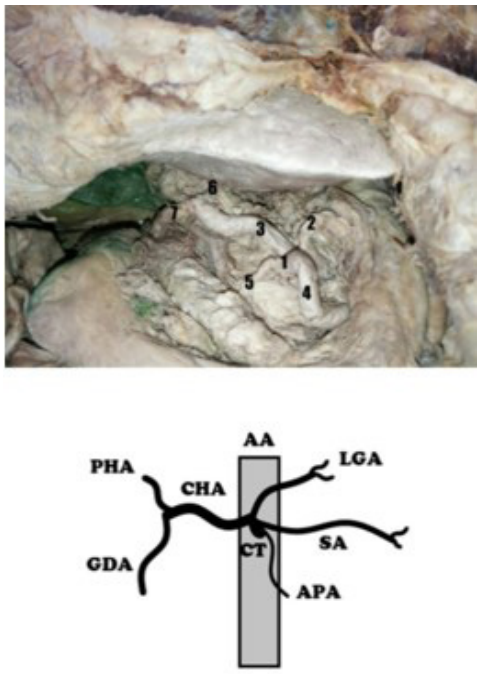

Figure 4. Abdominal aorta (AA), celiac trunk (1, CT), left gastric artery (2, LGA), common hepatic artery (3, CHA), splenic artery (4, SA), accessory pancreatic artery (5, APA), proper hepatic artery (6, PHA), gastroduodenal artery (7, GDA).

The authors found an accessory left inferior phrenic artery in one case, an accessory right phrenic artery in two cases, and an accessory lumbar artery in a fourth case.

Grigoriţă et al.[20] identified a celiac trunk with four branches: the common trunk for the left and right inferior phrenic arteries and the accessory LGA, CHA, and GST.

Abelleyra Lastoria et al.[21] described a case in which the celiac trunk is represented by five branches: the LGA, the SA, the gastroduodenal artery, the middle colic artery, and the jejunoileal artery. The proper hepatic artery is a branch of the superior mesenteric artery. Pinal-Garcia et al.[22] conducted a study on the dissection of 140 cadavers, which revealed the following findings: the celiac trunk was tetrafurcated in 46 cadavers (32.9%), pentafurcated in eighteen (12.9%), hexafurcated in two (1.4%), and heptafurcated in one (0.7%). In the case of celiac trunk heptafurcation, the arterial configuration was observed in one male cadaver. The left inferior phrenic artery was identified as the first arising vessel, followed by the left middle adrenal, right inferior phrenic, and left gastric arteries arising independently and finally resulting in a trifurcation. This trifurcation gave rise to the CHA, SA, and gastroduodenal arteries. Heptafurcation of the celiac trunk was described in a case report by Astik and Dave[23], where the authors found an atypical origin of the left superior and middle suprarenal arteries and the inferior diaphragmatic and gastroduodenal arteries from the celiac trunk, which divided into the typical LGA, SA, and CHA.

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Conclusion

This study identifies anatomical variations that confirm the high variability of the celiac trunk. These variations must be considered when planning or performing liver transplants, as well as gastric and pancreatic surgeries and imaging and endovascular procedures.

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Competing Interests

The authors have declared that no competing interests exist.

Author contributions

All listed authors have contributed to the preparation of this manuscript and have permitted their names to be included as co-authors.

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