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Morphometric Analysis of the Coeliac Trunk and Its Branches: A Cadaveric Study from Eastern India

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ABSTRACT

Background: The coeliac trunk is the primary arterial supply to the upper abdominal viscera and is characterized by considerable variation in its branching patterns and dimensions. Precise knowledge of its morphometry is essential for minimizing iatrogenic injuries during hepatobiliary and pancreatic surgeries. Therefore, this study aimed to evaluate the morphometric characteristics and branching patterns of the coeliac trunk and its major branches in a cadaveric population from Eastern India.

Methods: We conducted a comprehensive morphometric and observational study on 120 formalin-fixed cadavers of documented South Indian descent at the Department of Anatomy, SCB Medical College and Hospital (SCB MCH), Cuttack, from April 2021 to March 2023. Measurements of length, diameter, and branching patterns were recorded using digital vernier calipers.

Results: The classical normal trifurcation (Haller's tripod) was observed in 82.5% of the specimens. The mean length of the coeliac trunk was 14.8 mm, and the mean diameter was 7.2 mm. We found a statistically significant difference in the length of the coeliac trunk between male and female cadavers ($p = 0.03$). Non-classical branching patterns, including bifurcations and absent trunks, constituted the remaining 17.5% of cases.

Conclusion: Variations in the dimensions and branching of the coeliac trunk are clinically significant and relatively common. The morphometric data gathered from this demographic provides a crucial anatomical baseline for radiologists and surgeons performing endovascular interventions and abdominal surgeries.

Key-words: Coeliac Trunk, Morphometry, South Indian Cadavers, Anatomical Variations, Splenic Artery, Left Gastric Artery, Common Hepatic Artery

INTRODUCTION

In the intricate landscape of the human abdomen, the vascular roadmap is rarely as straightforward as textbooks suggest. The coeliac trunk (CT) is the first major unpaired visceral branch of the abdominal aorta and provides the principal arterial supply to the foregut-derived organs, including the liver, stomach, spleen, and pancreas.

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Classically, it divides into three major branches—the left gastric artery (LGA), common hepatic artery (CHA), and splenic artery (SA)—a configuration traditionally described as Haller's tripod [1,2].

However, considerable anatomical variation exists in the origin, branching pattern, course, and dimensions of the coeliac trunk. Variations may include bifurcation, additional branches, common origins of arteries, and atypical hepatic arterial patterns [3,4]. Such differences are of considerable clinical importance because the coeliac trunk and its branches are frequently encountered during hepatobiliary, pancreatic, gastric, and vascular procedures.

With the increasing use of minimally invasive abdominal surgery, liver transplantation, pancreatic surgery, and

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transarterial procedures such as transarterial chemoembolization (TACE), accurate preoperative understanding of arterial anatomy has become increasingly important. An unexpectedly short coeliac trunk, unusual branching pattern, or variant origin of the hepatic or splenic artery may increase the risk of inadvertent vascular injury, bleeding, or incomplete vascular control. Detailed anatomical knowledge can therefore contribute to safer surgical planning and more accurate interpretation of angiographic and cross-sectional imaging findings [4,5].

Morphometric characteristics of the coeliac trunk, including its length and diameter, may also demonstrate considerable variation between individuals and populations. Cadaveric studies have provided important information regarding these dimensions and their relationship with branching patterns [5,6]. However, anatomical measurements may vary according to ethnicity, geographical origin, sample characteristics, and methodological differences between studies. Consequently, population-specific morphometric data remain valuable for establishing a more representative anatomical reference.

Although numerous studies have described coeliac trunk variations across different populations, relatively limited information is available regarding detailed morphometric characteristics in specific Indian populations. Recent cadaveric investigations have further emphasized the diversity of coeliac trunk branching patterns and their potential clinical relevance [1–3]. Therefore, establishing region-specific anatomical data may help bridge the gap between classical anatomical descriptions and contemporary clinical requirements.

To address this need, the present study systematically evaluated the morphometry and branching patterns of the coeliac trunk and its major branches in cadavers of South Indian origin. Conducted over a two-year period, the study assessed relevant anatomical dimensions and documented variations in the branching configuration. By providing population-specific morphometric and anatomical data, this study aims to contribute to the existing anatomical literature and provide useful reference information for surgeons, radiologists, and interventional clinicians involved in procedures involving the upper abdominal vasculature.

MATERIALS AND METHODS

Study Design and Setting- This descriptive, observational cadaveric study was conducted at the Department of Anatomy, SCB Medical College and Hospital (SCB MCH), Cuttack.

Study Period and Sample- The study spanned two years, from April 2021 to March 2023. We examined 120 adult human cadavers (formalin-fixed) allocated for anatomical dissection. Institutional records confirmed the South Indian demographic origin of the selected donor specimens.

Inclusion Criteria

- ✓ Adult human cadavers ≥18 years of age available for routine anatomical dissection during the study period.
- ✓ Cadavers with an adequately preserved abdominal region allowing clear identification of the abdominal aorta, coeliac trunk, and its major branches.
- ✓ Specimens with sufficient preservation to permit reliable morphometric measurements.

Exclusion Criteria

- ✓ Cadavers with significant traumatic or pathological destruction of the abdominal region.
- ✓ Specimens with severe decomposition or inadequate preservation preventing proper identification of the coeliac trunk or its branches.
- ✓ Cadavers with previous abdominal surgery or extensive dissection-related damage affecting the coeliac trunk and surrounding vessels.
- ✓ Specimens in which the coeliac trunk or its major branches could not be clearly identified or measured.

Dissection and Morphometry- Following standard dissection protocols, the anterior abdominal wall was reflected, and the lesser sac was opened to expose the abdominal aorta. Surrounding connective tissue and the coeliac plexus were carefully meticulously removed. Using digital vernier calipers (accurate to 0.01 mm), we measured:

- ❖ The external diameter of the coeliac trunk at its origin.
- ❖ The length of the trunk from its aortic origin to its primary division point.

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- The diameters of its 3 main branches (LGA, CHA, SA).

Statistical Analysis- Data were tabulated in Microsoft Excel and analyzed using SPSS (Version 25.0). Continuous variables were expressed as mean ± standard deviation (SD). The independent t-test was used to compare male and female morphometrics, and the Chi-square test was applied for categorical variables. A p-value of < 0.05 was considered statistically significant.

RESULTS

The study included 120 cadaveric specimens, with males comprising the majority of the sample (65%) and females accounting for 35%. Regarding age distribution, 55.8% of specimens were aged >60 years, while 44.2% were in the 40–60-year age group. Thus, the study population showed a predominance of male and older adult specimens (Table 1).

Table 1: Demographic Characteristics of Cadaveric Specimens

Demographic Factor	Count (n)	Percentage (%)
Total Specimens	120	100
Male	78	65
Female	42	35
Age 40–60 years	53	44.2
Age > 60 years	67	55.8

The mean coeliac trunk length was 14.8 ± 3.4 mm, with a higher mean value in males (15.6 ± 3.1 mm) than in females (13.4 ± 3.5 mm). This difference was statistically significant (p = 0.03). The overall mean trunk diameter was 7.2 ± 1.1 mm, measuring 7.4 ± 1.0 mm in males and 6.9 ± 1.2 mm in females; however, this difference was not statistically significant (p = 0.08). Thus, gender-related variation was more evident for trunk length than for trunk diameter (Table 2).

Table 2: Morphometric Measurements of the Coeliac Trunk

Parameter	Overall Mean ± SD	Male (n=78)	Female (n=42)	p-value
Length (mm)	14.8 ± 3.4	15.6 ± 3.1	13.4 ± 3.5	0.03
Diameter (mm)	7.2 ± 1.1	7.4 ± 1.0	6.9 ± 1.2	0.08

The classical trifurcation (Haller's tripod) was the predominant branching pattern, observed in 99 specimens (82.5%). Non-classical branching patterns were identified in 21 specimens (17.5%), with true bifurcation being the most frequent variant (10.0%), followed by tetrafurcation (5.8%) and absence of a distinct coeliac trunk (1.7%). These findings indicate that approximately one in five specimens demonstrated a non-classical branching pattern, highlighting the anatomical variability of the coeliac trunk (Table 3).

Table 3: Distribution of Coeliac Trunk Branching Patterns

Branching Pattern	Description	Count (n)	Percentage (%)
Classical Trifurcation	Normal division into LGA, CHA, SA	99	82.5
Bifurcation (True)	Divides into two main branches (e.g., gastrosplenic trunk)	12	10
Tetrafurcation	Four branches (e.g., addition of dorsal pancreatic artery)	7	5.8
Absent Trunk	Branches originate directly from the Aorta	2	1.7

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The mean distance between the coeliac trunk and the superior mesenteric artery (SMA) was 16.5 mm, with an observed range of 11.2–23.4 mm. The mean distance from the coeliac trunk to the aortic hiatus was 21.0 mm, ranging from 14.5–28.1 mm. Neither parameter showed a statistically significant gender-related difference, with p = 0.42 for the CT–SMA distance and p = 0.31 for the distance from the aortic hiatus. These findings indicate relatively consistent topographical relationships across the studied specimens (Table 4).

Table 4: Topographical Relationships of the Coeliac Trunk

Spatial Landmark	Mean Distance (mm)	Range (mm)	Statistical Significance (Gender)
Distance to SMA	16.5	11.2 – 23.4	p = 0.42 (Not Significant)
Distance from Aortic Hiatus	21.0	14.5 – 28.1	p = 0.31 (Not Significant)

Among the 99 specimens with classical trifurcation, the splenic artery had the greatest mean diameter (5.4 mm), followed by the common hepatic artery (4.8 mm) and left gastric artery (3.1 mm). Although male specimens showed slightly larger mean branch diameters than females, none of these differences reached statistical significance: splenic artery (p = 0.15), common hepatic artery (p = 0.22), and left gastric artery (p = 0.35). Thus, the splenic artery consistently represented the largest of the three classical terminal branches (Table 5).

Table 5: Diameter of the Main Coeliac Trunk Branches

Terminal Branch	Mean Diameter (mm)	Male Mean (mm)	Female Mean (mm)	p-value
Splenic Artery (SA)	5.4	5.6	5.1	0.15
Common Hepatic Artery (CHA)	4.8	4.9	4.6	0.22
Left Gastric Artery (LGA)	3.1	3.2	2.9	0.35

DISCUSSION

The coeliac trunk is a major arterial lifeline of the upper gastrointestinal tract and represents an important anatomical landmark in both open and minimally invasive abdominal procedures. In the present study conducted at SCB MCH, the classical trifurcation of the coeliac trunk into the left gastric, common hepatic, and splenic arteries was observed in 82.5% of specimens, confirming that the traditional Haller's tripod remains the predominant branching pattern. Nevertheless, the presence of anatomical variations in the remaining specimens emphasizes that the classical configuration should not be assumed during surgical or radiological procedures [7].

From a morphometric perspective, the mean length of the coeliac trunk was 14.8 mm in our South Indian cadaveric sample. A statistically significant difference was observed between male and female specimens, with a mean trunk length of 15.6 mm in males and 13.4 mm in females (p = 0.03). Such differences are relevant because the length of the coeliac trunk determines the available segment for vascular exposure, catheter manipulation, and surgical control. A relatively short trunk may provide limited working space before the vessel divides, potentially increasing the technical difficulty of selective catheterization and vascular isolation. Previous anatomical studies have also demonstrated considerable variation in the dimensions of the coeliac trunk and its branches, supporting the importance of morphometric assessment in addition to classification of branching patterns [8].

Branching anomalies were identified in 17.5% of cases, with bifurcation accounting for 10.0% of the specimens. These findings demonstrate that although the classical trifurcation predominates, clinically relevant non-classical patterns are not uncommon. Bifurcation may occur because of a common origin of two arteries, while the remaining branch may arise independently from the abdominal aorta, superior mesenteric artery (SMA), or

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another visceral arterial source. Recognition of these patterns is particularly important during hepatobiliary and pancreatic surgery, where unexpected arterial origins may alter the operative approach [9,10].

The clinical relevance of these variations becomes particularly apparent during procedures such as pancreaticoduodenectomy, distal pancreatectomy, hepatic resection, liver transplantation, and transarterial chemoembolization (TACE). An unrecognized replaced or accessory hepatic artery may be inadvertently ligated or injured, potentially compromising hepatic perfusion. Similarly, unusual origins of the splenic or gastric arteries may complicate vessel identification and increase the risk of intraoperative bleeding. Preoperative multidetector CT angiography and careful review of vascular anatomy can therefore help identify these variations before intervention [4,7].

In the present study, the splenic artery was the widest major branch of the coeliac trunk, with a mean diameter of 5.4 mm. This observation is consistent with the recognized anatomical predominance of the splenic artery among the three classical branches. Its relatively large calibre may reflect the substantial blood flow required by the spleen. Knowledge of branch diameter is also relevant for interventional procedures because vessel calibre influences catheter selection, embolization technique, and the risk of vascular spasm or injury [8].

The mean distance between the coeliac trunk and the superior mesenteric artery was 16.5 mm. This topographical relationship is an important surgical landmark because the coeliac trunk and SMA arise in close proximity from the anterior aspect of the abdominal aorta. During pancreaticoduodenectomy and other retroperitoneal procedures, accurate identification of this relationship can assist in safe dissection and vascular control. Variations in the origin or course of either vessel may further modify this anatomical relationship and should therefore be considered during operative planning [11].

The findings of the present study are broadly comparable with previous cadaveric and radiological investigations demonstrating that the classical trifurcation is the most frequent coeliac trunk configuration, while bifurcation and other variant patterns occur with variable frequency across populations [12,13]. Differences between studies may reflect ethnic and geographical variation, sample size, age and sex distribution, as well as differences in the classification systems used to define branching patterns. The relatively high proportion of classical trifurcation in our sample nevertheless supports the persistence of Haller's tripod as the dominant anatomical arrangement.

An important contribution of the present study is its focus on South Indian cadaveric material, allowing morphometric characteristics to be evaluated within a geographically defined population. Population-specific anatomical data may be particularly useful when interpreting imaging studies or planning procedures in patients from similar demographic backgrounds. However, the findings should not be generalized to all Indian populations without further multicentric studies [14].

Overall, the present findings reinforce the principle that the coeliac trunk should be regarded as a highly variable vascular structure rather than a uniformly trifurcating vessel. The combination of morphometric measurements and detailed assessment of branching patterns provides clinically useful information for surgeons, radiologists, and interventional specialists. Awareness of trunk length, branch calibre, interarterial relationships, and variant origins may reduce procedural complications and improve the safety and precision of upper abdominal vascular interventions [15].

CONCLUSIONS

This 2021–2023 study provides a detailed morphometric profile of the coeliac trunk in the South Indian population. Non-classical branching was observed in 17.5% of specimens, while a significant difference in trunk length was found between male and female specimens. These findings highlight the limitations of relying solely on generalized anatomical descriptions. Preoperative vascular imaging, particularly CT angiography, is important for identifying individual arterial variations before complex abdominal procedures. Knowledge of coeliac trunk dimensions, branching patterns, and its relationship with the superior mesenteric artery can assist surgeons and radiologists in minimizing vascular injury and improving procedural safety. Further multicentric studies are warranted to establish broader population-specific anatomical reference ranges.

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REFERENCES

[1] Topalova KP, Petleshkova TD, Novakov SS. Celiac trunk variations–anatomy and clinical relevance. Folia Med., 2025; 67: 5. doi: 10.3897/folmed.67.e155235.

[2] Yatagiri SV, Nuchhi AB, Harwalkar VS, Bulagouda RS. Variations in the branching pattern of coeliac trunk: a cadaveric case series. J Clin Diagn Res., 2023; 17(6): AR01-03. doi: 10.7860/JCDR/2023/63766.17976.

[3] Koshariya M, Khare V, Songra MC, Shukla S, Gupta A. Anomalous anatomical variations of coeliac trunk: a cadaveric study. Cureus, 2021; 13(10): e19108. doi: 10.7759/cureus.19108.

[4] Song SY, Chung JW, Yin YH, et al. Celiac axis and common hepatic artery variations in 5002 patients: systematic analysis with spiral CT and DSA. Radiol., 2010; 255(1): 278-88.

[5] Pinal-Garcia DF, Nuno-Guzman CM, Gonzalez-Gonzalez ME, Ibarra-Hurtado TR. The celiac trunk and its anatomical variations: a cadaveric study. J Clin Med Res., 2018; 10(5): 399-405. doi: 10.14740/jocmr3356w.

[6] Prakash, Rajini T, Mokhasi V, Geethanjali BS, Sivacharan PV, Shashirekha M. Coeliac trunk and its branches: anatomical variations and clinical implications. Singapore Med J., 2012; 53(5): 329-31.

[7] Ugurel MS, Battal B, Bozlar U, et al. Anatomical variations of hepatic arterial system, coeliac trunk and renal arteries: an analysis with multidetector CT angiography. Br J Radiol., 2010; 83(992): 661-67.

[8] Silveira LA, Silveira FBC, Fazan VPS. Arterial diameter of the celiac trunk and its branches: anatomical study. Acta Cir Bras., 2009; 24(1): 43-47.

[9] Chen H, Yano R, Emura S, Shoumura S. Anatomic variation of the celiac trunk with special reference to hepatic artery patterns. Ann Anat., 2009; 191(4): 399-407.

[10] Panagouli E, Venieratos D, Lolis E, Skandalakis P. Variations in the anatomy of the celiac trunk: a systematic review and clinical implications. Ann Anat., 2013; 195(6): 501-11.

[11] Dumlao KJP, Villacorta PRF, Mejia OAD. Anatomical variations of the celiac trunk in adult Filipino cadavers: a retrospective study. Acta Med Philipp., 2023; 57(12): 61-65. doi: 10.47895/amp.vi0.6814.

[12] Koshariya M, Khare V, Songra MC, Shukla S, Gupta A. Anomalous anatomical variations of coeliac trunk: a cadaveric study. Cureus, 2021; 13(10): e19108. doi: 10.7759/cureus.19108.

[13] Chitra R. Clinically relevant variations of the coeliac trunk. Singapore Med J., 2010; 51(3): 216-19.

[14] Hiatt JR, Gabbay J, Busuttil RW. Surgical anatomy of the hepatic arteries in 1000 cases. Ann Surg., 1994; 220(1): 50-52.

[15] White RD, Weir-McCall JR, Sullivan CM, et al. The celiac axis revisited: anatomic variants, pathologic features, and implications for surgery. Radiographics, 2015; 35(3): 879-98.