

CLINICAL STUDY

Atypical variable origins of the left inferior phrenic artery and left gastric artery

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ABSTRACT

OBJECTIVES: The current report describes the combined unusual origin of the left inferior phrenic and left gastric arteries observed during a routine dissection of the upper abdominal region.

BACKGROUND: The branches of the abdominal aorta are important vessels that supply blood to various organs and structures in the abdominal cavity. While there is typically a common pattern of branching, anatomical variations can occur, leading to differences in the branching patterns of the abdominal aorta.

METHODS: An accidental finding in an 80-year-old male cadaver within anatomical dissection was assessed.

RESULTS: We observed that the left inferior phrenic artery originated from the celiac trunk and gives off middle and superior suprarenal arteries, while the left gastric artery arose from the abdominal aorta independently.

CONCLUSION: The identification of anatomic vascular abnormalities of the abdominal aorta and its branches is clinically important in surgical and invasive arterial procedures and preoperative knowledge of vascular anomalies should prevent iatrogenic vascular trauma and complications during surgery (*Fig. 3, Ref. 14*). Text in PDF www.elis.sk

KEY WORDS: variation, inferior phrenic artery, left gastric artery, aorta, dissection.

Introduction

Anatomical variations including the parietal and visceral branches of abdominal aorta are common. The inferior phrenic artery (IPA) arises immediately inferior to the aortic hiatus of the diaphragm directly from the abdominal aorta and provides arterial supply to the suprarenal gland, although it also participates in the supply of the oesophagus, stomach, spleen, liver, and adjacent structures. It continues on to the inferior surface of the diaphragm. The IPA expresses a wide range of variation in origin. It may arise from the abdominal aorta (46.8 %), celiac trunk (46.1 %), and renal arteries (1.47 %) (1), splenic artery, superior mesenteric artery, or gonadal arteries (2). Variations in the IPA can influence surgical procedures and radiological interventions and contribute to the development of collateral circulation. The significance of the IPA in surgical procedures such as liver resections, diaphragmatic repair, adrenal gland surgeries and gastric surgeries is discussed. Understanding the anatomical variations of the IPA is crucial to avoid intraoperative complications and improve surgical outcomes. The IPA has gained increasing importance in minimally invasive radiological procedures, including transcatheter arterial embolisation, for various conditions. Interest in the variable origin of the

inferior phrenic arteries increase due to their role in the extrahepatic blood supply of hepatocellular carcinoma (3).

Anomalies involving the left gastric artery (LGA) occur less frequently but are still relatively common, being seen in approximately 0.5–15 % cases (4). LGA is one of the three main branches of the celiac trunk. It runs to the upper left behind the omental bursa to reach the cardiac end of the stomach. The vessel is usually stronger than the right one with which it anastomoses on the lesser stomach curvatures (5). Understanding LGA variations is crucial for surgical planning to avoid complications and ensure optimal outcomes.

Usually, the vascular variations are asymptomatic, and they are identified incidentally during surgery or cadaveric dissection. The aim of the present case is the description of a rare variation of the left inferior phrenic artery originating from the celiac trunk and of the left gastric artery arising directly from the abdominal aorta, observed during the routine dissection of a male cadaver. These anatomical variations are clinically significant for surgical procedures performed in the supramesocolic part of the abdominal cavity.

Material and methods

The anatomical variation was found in a cadaver of 80-year-old man during the anatomical dissection course for underground medical students at the Department of Anatomy of PJ Safarik University in Košice. The cadaver was obtained from the body donation programme following receipt of a signed informed con-

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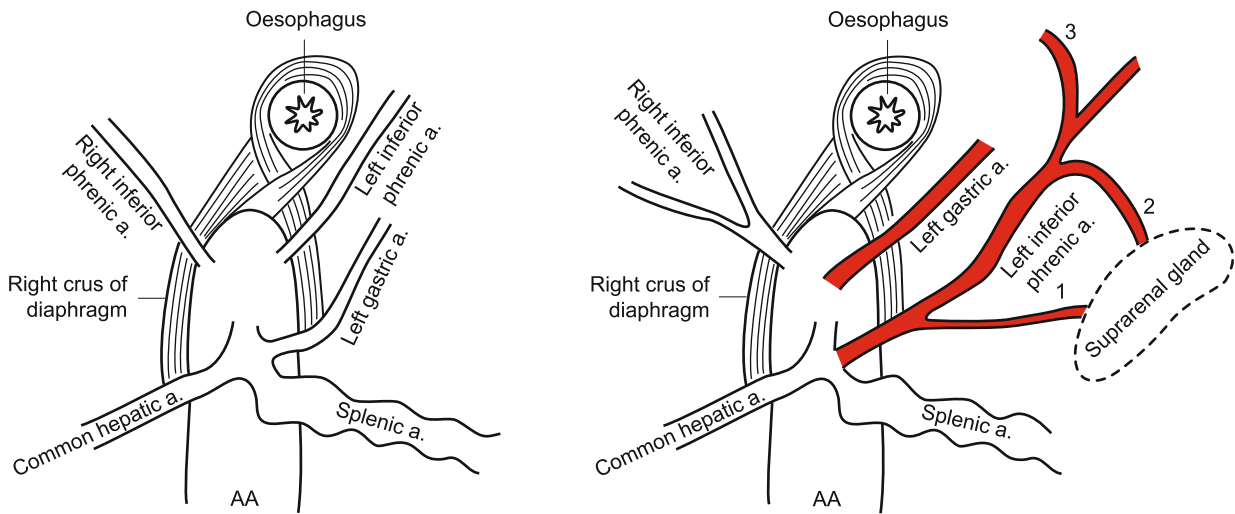


Fig. 1. Schematic drawing of the origin of the abdominal aorta branches. A. standard branching pattern; B. variable origin: LGA from abdominal aorta, LIPA from celiac trunk. 1 – middle suprarenal a., 2 – superior suprarenal a., 3 – recurrent br., AA – abdominal aorta.

sent form from the donor himself. The complete medical history of the cadaver was not available. The dissection was carried out according to the instruction by Mráz et al (1995), Loukas et al (2018) (7). The cadaver had been embalmed soon after death and preserved by the injection of formalin preservative solution. The dissection was performed in accordance with ethical standards and legal requirements. All measurements were performed using a sliding calliper gauge. Each measurement was carried out twice with an accuracy of up to 0,05 mm.

Results

During routine anatomical dissection in the retroperitoneal space, we observed anatomical variation in the origin of the left inferior phrenic and left gastric arteries. The dissection was conducted with the male cadaver in supine position. After removing the anterior abdominal wall and dissecting the abdominal viscera, we reached the posterior part of the peritoneum which covers the retroperitoneal space. Through the peritoneum of the posterior wall of the omental bursa, branches of the abdominal aorta were dissected. We observed a variation in the division of the abdominal aorta (Fig. 1). After reflecting the stomach laterally, a celiac trunk (CT) arising from the anterolateral aspect of the abdominal aorta was identified. The CT was approximately 23 mm long and then divided into the splenic artery and common hepatic artery. In ad-

dition, the left inferior phrenic artery (LIPA) originated from the beginning of the celiac trunk. The LIPA passes to the left over the left crus of the diaphragm and gives off middle and superior suprarenal arteries and as well as a recurrent branch for the oesophagus (Fig. 2). The external diameter of the left inferior phrenic artery measured 3.6 mm. The right inferior phrenic artery arises directly

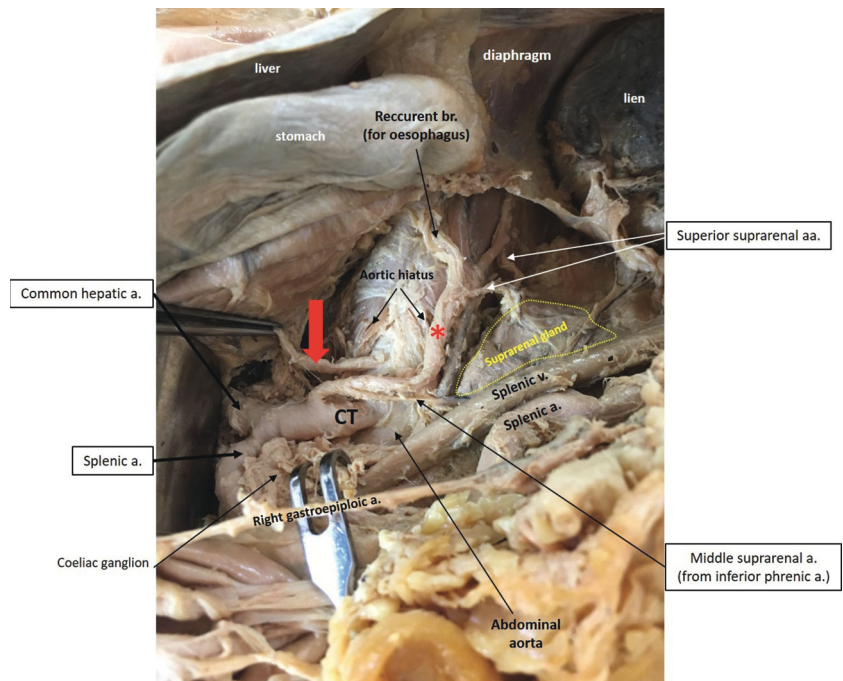


Fig. 2. Left inferior phrenic artery (*) originating directly from the celiac trunk and extra-celiac origin of the left gastric artery (red arrow). CT- celiac trunk.

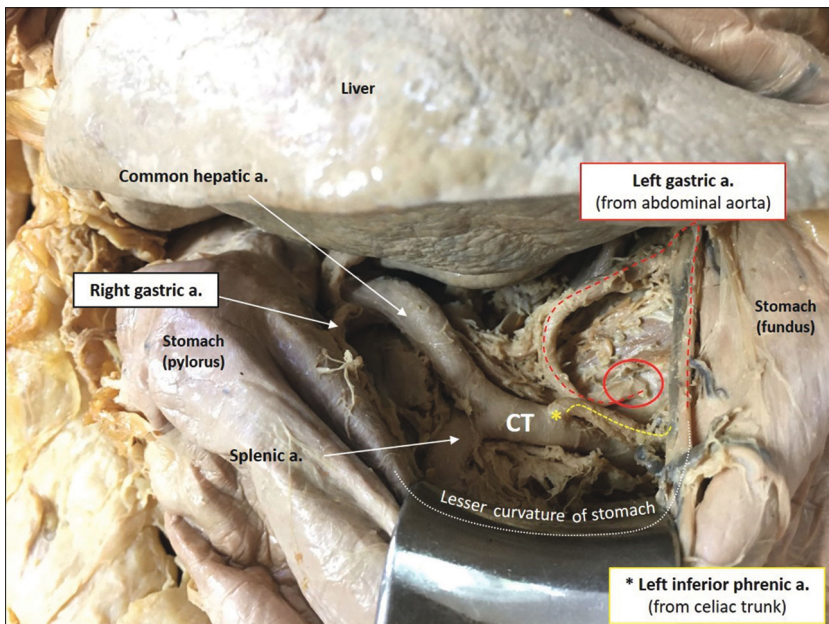


Fig. 3. Variable origin and course of the left inferior phrenic artery and left gastric artery. CT- celiac trunk.

from the abdominal aorta, as is typically expected. Along the lesser curvature of the stomach, the left gastric artery was identified. We traced the LGA, which originates in an unconventional manner, directly from the right anterolateral aspect of the abdominal aorta, approximately 9.5 mm above the celiac trunk. The external diameter of the left gastric artery measured 3.5 mm. The right gastric artery originated standardly from the proper hepatic artery, and both arteries formed an anastomosis at the level of the lesser curvature of the stomach (Fig. 3). The two other branches of the celiac trunk, namely the splenic and common hepatic artery, had a typical origin and distribution.

Discussion

The inferior phrenic arteries usually originate as the first branches from the abdominal aorta. They pass anterolaterally on the undersurface of the diaphragm. Before terminal bifurcation, the ascending and descending branch gives off superior suprarenal arteries to supply the suprarenal gland (8). The left inferior phrenic artery most commonly arises from the aorta (9). In the present case report, we have described anatomical variation in the origin of the left inferior phrenic and left gastric arteries. During a routine dissection, we identified the origin of the LIPA from the celiac trunk. The LIPA passes along the anterolateral surface of the diaphragm and gives off the middle and superior suprarenal arteries. The middle suprarenal artery usually arises directly from the abdominal aorta. Szewczyk et al (2021) (10) identified 6 types of origin of the IPA. Type 4, subtype 4B, in which the LIPA originated from the celiac trunk and the RIPA from AA was seen in 12.48 % of the cadavers. Whitley et al (2021) (1) reported the inferior

phrenic arteries arising from the common inferior trunk in 24.2 % of cases and in the retrieval percentage as independent vessels. In 9.6 % of cases, the inferior phrenic artery originated from the abdominal aorta as a common trunk with the common hepatic artery or in isolation (1.6 % of cases) (11). The anomalous origin and branching of the left inferior phrenic artery is important in intravascular interventions, such as arterial chemoembolization to prevent the spread of liver carcinoma and transarterial embolization to prevent blood loss in patients with significant haemoptysis.

The type of variable origin of the IPA varies depending on the occurrence of other abdominal vascular variations; in particular, the origin of the IPA may be different in the presence of CT variations. In our case, except for the variable origin of the left inferior phrenic artery, we found a nonstandard origin of the left gastric artery. The LGA originated as a single branch directly from the right anterolateral aspect of the abdominal aorta, instead of being

a branch of the celiac trunk, as expected. The origin of the LGA was approximately 10 mm below the aortic hiatus and 10 mm above the beginning of the celiac trunk. In 2–6 % of cases, the LGA arose directly from the abdominal aorta and from the inferior phrenic arteries in 5 %, with the most common variation being origination from the common hepatic artery (20–30 %) (12). Jadhav et al (2016) (13) reported a 1.6 % incidence of the left gastric artery originating from the aorta. The origin of these variations has an embryological explanation. Longitudinal anastomosis between the four roots of the omphalomesenteric artery is responsible for variation of the visceral branches of the abdominal aorta (AA). The left gastric, common hepatic and splenic arteries arise from longitudinal anastomosis and are separated from the fourth root. If the second and third roots remain persistent, this results in a separate origin of the visceral branches from the AA (14). In the current case, the first root did not fuse with the second root, resulting in the LGA originating directly from the AA. Variations of the LGA have an incidence of 0.5–6 % in the literature (13). The combination of variable origins of the left inferior phrenic artery from the celiac trunk and the right one arising from the AA and variable origin of the left gastric artery from the AA is rare and should be kept in mind while performing surgery in the upper abdominal region. Vascular anomalies of the branches of the abdominal aorta are asymptomatic but become important in patients undergoing invasive radiological procedures or laparoscopic surgery in the abdominal viscera. Understanding the anatomical variation of the gastric and phrenic arteries is essential when performing perivascular lymph node dissection, as there is a higher incidence of lymph node metastasis in the LGA in cases of gastric carcinoma.

In summary, the variable origin of branches of the abdominal aorta can have clinical significance in surgical planning, radiological evaluation, the management of gastrointestinal bleeding and various interventional procedures in the abdominal cavity.

References

1. Whitley A, Křeček J, Kachlik D. The inferior phrenic arteries: A systematic review and meta-analysis. *Ann Anatomy-Anatomischer Anzeiger* 2021; 235: 151679.
2. Gwon D, Ko GY, Yoon HK, Sung KB, Lee JM, Ryu SJ, Kim HK. Inferior phrenic artery: anatomy, variations, pathologic conditions, and interventional management. *Radiographics* 2007; 27(3): 687–705.
3. Cazejust J, Bessoud B, Colignon N, Garcia-Alba C, Planché O, Menu Y. Hepatocellular carcinoma vascularization: from the most common to the lesser known arteries. *Diagnostic and interventional imaging* 2014; 95(1): 27–36.
4. Dogan NU, Fazliogullari Z, Yilmaz MT, Uysal II, Cicekcibasi AE, Ulusoy M, Gunaslan P. A complex variation of the parietal and visceral branches of the abdominal aorta. *Int J Morphol* 2011; 29: 90–93.
5. Paulsen F, Böckers TM, Waschke J (Eds.). *Sobotta anatomy textbook: English edition with Latin nomenclature*. Elsevier Health Sciences, 2018.
6. Mráz P et al. *Pitevné cvičenia*. Martin, Osveta, 1995.
7. Loukas M, Benninger B, Tubbs RS. *Gray's Clinical photographic dissector of the human body*. Elsevier Health Sciences, 2018.
8. Moore K, Dalley A, Agur A. Chapter 7: Head. *Clinically Oriented Anatomy*. Philadelphia. 2014.
9. Tubbs RS, Shoja MM, Loukas M (Eds). *Bergman's comprehensive encyclopedia of human anatomic variation*. John Wiley & Sons, 2016.
10. Szewczyk B, Karauda P, Podgórski M, Waśniewska A, Haładaj R, Rapacka E, Polgaj M. Types of inferior phrenic arteries: a new point of view based on a cadaveric study. *Folia Morphologica* 2021; 80 (3): 567–574.
11. Ugurel MS, Battal B, Bozlar U, Nural MS, Tasar M, Ors F, Karademir I. Anatomical variations of hepatic arterial system, celiac trunk and renal arteries: an analysis with multidetector CT angiography. *Brit J Radiol* 2010; 83 (992): 661–667.
12. Gore RM, Levine MS. *Textbook of gastrointestinal radiology*. Elsevier Health Sciences, 2014.
13. Jadhav SD, Zambare BR. Variation of the Left Gastric and Right Inferior Phrenic Arteries: Its Clinical Implication. *Indian J Anat* 2016; 5 (2): 193.
14. Tandler J. Über die Varietäten der Arteria celiaca und deren Entwicklung. *Anatomische Hefte* 1904; 25 (2): 473–500.

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