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Variation in Site of Origin of Inferior Phrenic Arteries

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Abstract

The inferior phrenic arteries, a pair of important vessels, supply multiple organs including the diaphragm, adrenal glands, esophagus, stomach, liver, inferior vena cava, and retroperitoneum. The majority (80–90%) of inferior phrenic arteries originate as separate vessels from either the abdominal aorta or the coeliac trunk. Infrequently, the right and left inferior phrenic arteries can arise in the form of a common trunk from the aorta or from the coeliac trunk. During this study 60 cadavers were dissected and variation in the site of origin of inferior phrenic arteries was noted. Out of 60 cadavers, 49 cadavers showed normal origin of inferior phrenic artery i.e. right and left inferior phrenic artery arise individually from abdominal aorta. 3 cadavers showed both inferior phrenic arteries arising from abdominal aorta as single root. 5 cadavers showed both inferior phrenic artery arising as single trunk from celiac trunk and 2 cadavers shows individual origin of right and left inferior phrenic artery from celiac trunk. 1 cadaver showed right inferior phrenic artery coming from abdominal aorta and left inferior phrenic artery coming from celiac trunk. As right and sometimes left inferior phrenic artery plays important role in the blood supply of hepatocellular carcinoma and frequently supplies HCCs located in the bare area of the liver. and as an unresectable hepatocellular carcinoma can be treated by transcatheter embolization so the knowledge of variation in origin of inferior phrenic artery is important. Other pathologic conditions including hemoptysis, diaphragmatic or hepatic bleeding due to trauma or surgery, and bleeding caused by gastroesophageal problems (eg, Mallory-Weiss tear or gastroesophageal cancer) may be related to the inferior phrenic artery. Radiologists must be familiar with the normal spectrum of inferior phrenic artery anatomy so that detection and adequate interventional management can be achieved when pathologic conditions related to the inferior phrenic artery are present.

Keywords: Inferior Phrenic Artery; Hepatocellular Carcinoma.

Introduction

Although descriptions of the right inferior phrenic artery and left inferior phrenic artery are typically very brief and lacking in detail in anatomy textbooks, they have received increased attention in recent years in the clinical literature [9]. There are many pathologic conditions related to the inferior phrenic artery , the most common of which is extrahepatic collateral supply of hepatocellular carcinoma (HCC) [4]. Indeed, the great importance of such knowledge lies in the fact that an unresectable HCC can be treated by transcatheter embolization of not only its typical blood supply, the right or left hepatic arteries, but also by embolization of a right inferior phrenic artery, if involved. Accordingly, with the appropriately targeted utilization of certain current cancer treatments hinging on a thorough knowledge of the origin of the inferior phrenic artery, our current study aimed at establishing this very fact [9]. To detect involvement of the inferior phrenic artery at an early stage, radiologists should be familiar with the spectrum of possible extrahepatic collateral supply

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by the inferior phrenic artery. The inferior phrenic artery can contribute to hemoptysis, especially when the pulmonary abnormality involves the lung base. Other pathologic conditions, such as diaphragmatic or hepatic bleeding due to trauma or surgery and bleeding resulting from gastroesophageal problems (eg, Mallory-Weiss tear and gastroesophageal cancer) may also be related to the inferior phrenic artery. In these cases, interventional management of the inferior phrenic artery should be attempted to increase therapeutic efficacy.

To effectively treat pathologic conditions related to the inferior phrenic artery, radiologists should be familiar both with the anatomy and variations of the normal inferior phrenic artery and with its imaging appearance at computed tomographic (CT) and conventional angiography [4].

Method

The Dissection of the abdominal aorta was carried out in 60 cadavers which were embalmed using 10% formalin. Each cadaver was kept in supine position, it was numbered. Each cadaver was dissected according to guidelines of "Cunningham's Manual of Practical Anatomy" volume 2, 15th edition. After proper exposure of abdominal aorta , the inferior phrenic artery was traced to its origin and the variations were noted.

Inclusion Criteria

Cadavers of either sex with age group between 25 to 75 years

Exclusion Criteria

Cadavers of any other age than mentioned above were excluded. Cadavers showing anomalous tortuosities, dilatation and aneurysms of abdominal aorta were excluded.

Result

Out of 60 cadavers, 49 cadavers (81.7 %) showed normal origin of Inferior Phrenic Artery i.e. right and left inferior phrenic artery arise individually from abdominal aorta. 3 (5%) cadavers showed both Inferior Phrenic Arteries arising from abdominal aorta as single root. 5 (8.3%) cadavers showed both inferior phrenic artery arising as single trunk from coeliac trunk and 2 (3.3%) cadavers shows individual

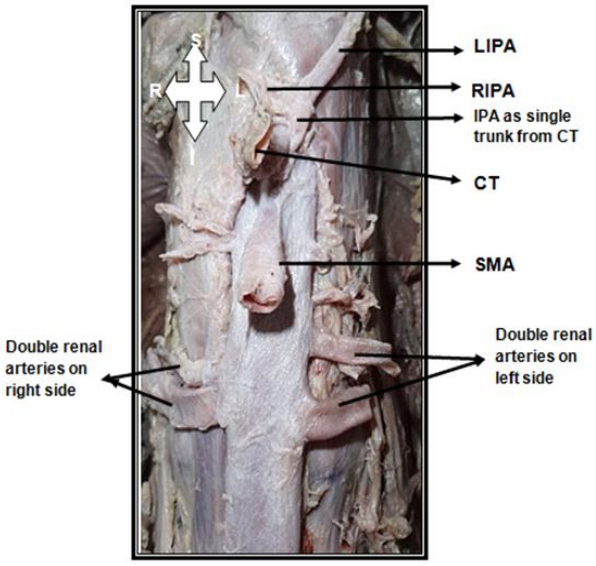

Fig. 1: Origin of IPA as single trunk from CT

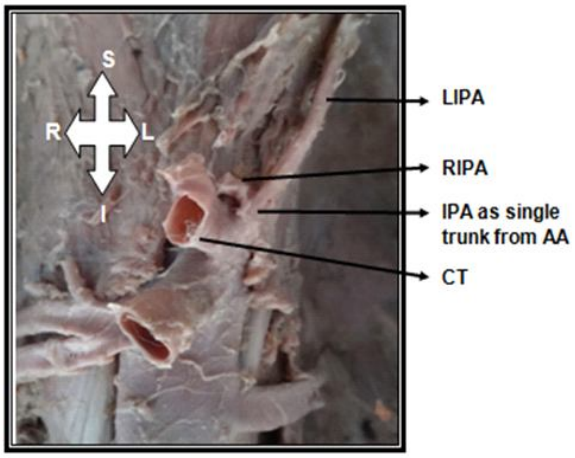

Fig. 2: Origin of IPA as single trunk from AA

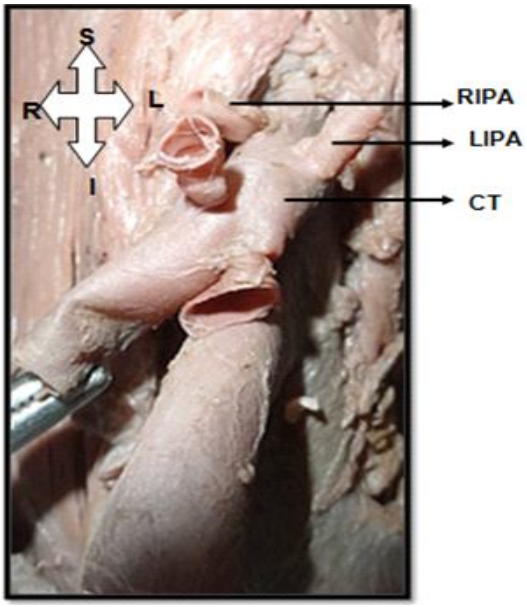

Fig. 3: Origin of LIPA from CT and RIPA from AA.

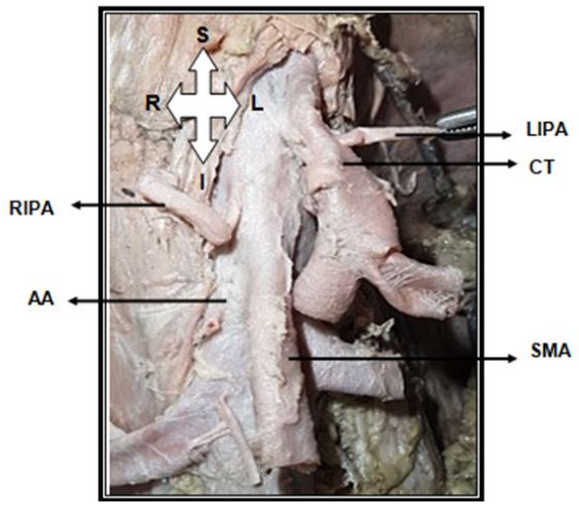

Fig. 4: Origin of LIPA and RIPA from CT individually

Abbreviations used in Figures-

AA - Abdominal Aorta

CT - Coeliac Trunk

IPA - Inferior Phrenic Artery

LIPA - Left Inferior Phrenic Artery

RIPA - Right Inferior Phrenic Artery

SMA - Superior Mesenteric Artery

origin of right and left inferior phrenic artery from celiac trunk. 1 (1.6%) cadaver showed right inferior phrenic artery coming from abdominal aorta and left inferior phrenic artery coming from celiac trunk.

Discussion

Inferior phrenic artery variations have recently caught up attention due to their clinical relevance in conditions such as hepatocellular carcinoma, extra bronchial collateral anastomoses as a source of hemoptysis, gastroesophagal pathologies, and various radiological interventions. In the present study variations in origin of inferior phrenic artery were studied. It was observed that 11 out of 60 cadavers showed variations in origin of inferior phrenic arteries which is statistically significant. Origin of Inferior Phrenic Arteries from coeliac trunk was recorded in 7 cadavers; among these 5 (8.3%) cadavers show both inferior phrenic arteries arising as single trunk (Figure 1) and 2 (3.3%) cadavers show individual origin of right and left inferior phrenic artery from coeliac trunk (Figure 4). Both Inferior Phrenic Arteries arise from abdominal aorta as single root in 3 (5%) cadavers (Figure 2). In 1 (1.6%) cadaver it is seen that right inferior phrenic is arising from abdominal aorta and left inferior phrenic is arising from coeliac trunk (Figure 3). Variations in origin of Inferior Phrenic Artery were also noticed in previous studies.

Pick and Anson (1940) [8] evaluated the largest series regarding the origin of the inferior phrenic artery. They reported the origin of this artery as follows: 47% from aorta, 40% from coeliac trunk, 10.5% from right renal artery, 2% from left gastric artery and 0.5% from hepatic artery. Knowledge of all possible variations and particularly the origins of the left and right inferior phrenic arteries may be useful in the treatment of hepatic, suprarenal or diaphragmatic lesions.

Cavdar et al.(1998)[2]: reported a case of left IPA and left gastric artery arising from the long CT via a common trunk .

Loukas et al.(2005) [6]: studied 300 cadavers and determined that right and left IPA originated from Coeliac trunk in 40% and 47% of the specimens, respectively.

Pulakunta T et al (2007) [9] noted a variant origin of inferior phrenic artery in 4 out of 32 cases. It was seen to arouse directly from the coeliac trunk in two cases and one case showed origin of inferior phrenic artery from the left gastric artery and another from the right renal artery.

Songur et al. (2010) [10]: studied 95 cadavers and found that inferior phrenic artery arose from celiac trunk as a common trunk in 3 cases (3.1%).

Uysal I I (2010) [11] reported a case, where both inferior phrenic arteries arouse from abdominal aorta as a single trunk, and the diameter of single trunk was about 10.4 mm.

Akhilandeswari B. and Ranganath P. (2013) [1] studied variation in the source of origin of inferior phrenic artery in 32 formalin-fixed cadavers. Of the 64 arteries (32 right and 32 left phrenic arteries) studied, 34 arteries (18 RIPA and 16 LIPA) had normal origin from aorta. The IPA arose from the coeliac trunk in 18 sides (6 RIPA and 12 LIPA) from renal artery in 10 sides (6 RIPA and 4 LIPA). Other origins of IPA i.e. from superior mesenteric artery were seen in 2 arteries and both were RIPA.

The IPA is a major source of collateral or parasitized arterial supply to haepatocellular carcinoma (HCC), second only to the hepatic artery [6]. Because transcatheter embolization of HCC and other hepatic neoplasms often involves finding the root of the RIPA, the interventional radiologist or oncologist could potentially benefit from knowledge of common

variations in origin of these vessels and their respective frequencies of occurrence. The importance of the IPA is not limited to the treatment of HCC. Practically any hepatic neoplasm (including metastatic disease to the liver) may receive blood supply from the IPA. In addition, there have been reports of gastric haemorrhage due to bleeding from the LIPA after treatment of the left gastric artery with embolization [7].

Thorough knowledge of the vascular anatomy and variations of the IPA is critical to effective interventional treatment of the pathologic conditions related to the IPA. In patients with hemoptysis, the bronchial arteries are the primary source of bleeding. In addition to the bronchial arteries, many systemic arteries—such as the inferior phrenic, intercostal, thyrocervical, internal mammary, thoracodorsal, and lateral thoracic arteries—serve as nonbronchial systemic collaterals that also contribute to hemoptysis. The IPA and other nonbronchial systemic collaterals are consequently assumed to reduce the therapeutic effect of embolization [3]. Therefore, it is important to recognize the IPA during transarterial embolization in patients with hemoptysis, especially when the pulmonary abnormality involves the lung base.

Other pathologic conditions, such as diaphragmatic or hepatic bleeding due to trauma or surgery may be related to the IPA . During liver transplantation, ligation of the right IPA is necessary for hepatectomy in the recipient and for right hepatic lobectomy in a living donor. If the ligation of this artery is not maintained adequately, bleeding from the IPA can occur after liver transplantation. [5]. In such cases, it is important to keep in mind the possibility of IPA bleeding, and careful evaluation of CT scans may be helpful in locating the origin of the IPA and active bleeding foci [4].

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