

Inferior Phrenic Artery-variation in Origin and its Clinical Implication: a Case Study

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ABSTRACT

Introduction: the inferior phrenic arteries are involved in many diseases, such as hepatocellular carcinoma, where they are the main vessels responsible for the collateral arterial supply secondary to hepatic artery.

Case Report: during the routine dissection of a 60 year-old male cadaver a vascular variant is found in the abdominal cavity where the right inferior phrenic artery (RIPA) is derived from the right renal artery and left inferior phrenic artery (LIPA) is from celiac trunk.

Conclusion: this finding is clinically important since the transcatheter embolization of hepatocellular carcinoma frequently involves the root of the right inferior phrenic artery and left inferior phrenic in gastric diseases. So its variation in source and course must to known before carrying out vascular and reconstructive surgeries and in evaluation of angiographic images.

Keywords: Celiac trunk; Hepatocellular carcinoma; Inferior phrenic artery; Renal artery.

Introduction

Inferior phrenic arteries (Phrenicae inferiores) are paired, small and first lateral aortic branches, which supply the diaphragm. The right phrenic occupies the bare area of liver where it supplies liver. The left phrenic passes behind the oesophagus, where it gives branches to the oesophagus and stomach. Information regarding the variations in origin and functional anatomy of both the phrenic arteries is very brief in text books. Further right inferior phrenic artery is the most common extra hepatic feeding artery supplying the hepatocellular carcinoma. The importance of such knowledge lies in the fact that an unresectable hepatocellular carcinoma can be treated by transcatheter embolization of not only by hepatic artery, but also by embolization of right inferior phrenic artery, if involved¹. By knowing the previous facts our case is just an addition to verify those variations so that such documentation could be useful during treatment of hepatic neoplasm, liver transplants and biliary tract surgeries.

Material and Methods

This finding was found during routine dissection of abdomen in a 60 year old adult male cadaver in the department of Anatomy. By following the instructions of Cunningham's manual the abdomen was opened up². After the removal of lesser omentum, the proximal part of abdominal aorta and its branches were traced out. Later after the removal of the stomach and pancreas the origin of inferior phrenic arteries were confirmed.

Results

As the origin of arteries were seen RIPA took its origin from right renal artery and LIPA arose from celiac trunk other than its normal branches as seen in figure 1 and 2. The importance of its origin from various sources lies in the fact that hepatocellular carcinoma was exclusively irrigated by its parent hepatic arteries¹. However, later on collateral arterial supply by the phrenic arteries may start as a consequence of injecting antitumor drugs inside the hepatic arteries, transcatheter embolisation(TACE) or surgical ligation of the hepatic arteries^{1,3}. The communication between intrahepatic arteries and inferior phrenic artery is highest at the posterior segment of caudate lobe. In cases of occlusion or severe stenosis of hepatic arteries after repeated TACE, the hepatic arteries are mainly reconstituted through the RIPA⁴.

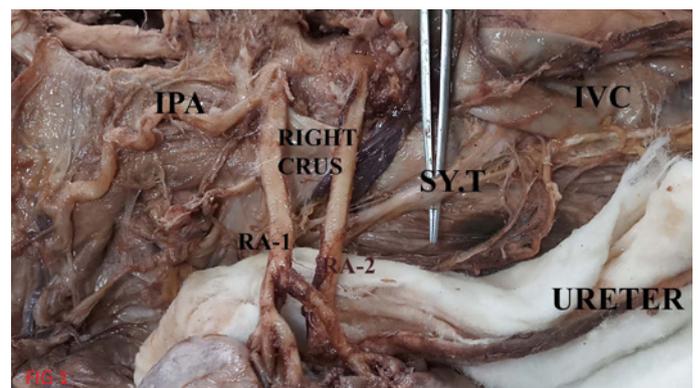


Figure 1. Right inferior phrenic artery (IPA) arising from right renal artery(two in number RA-1, RA -2),SY.T –sympathetic trunk

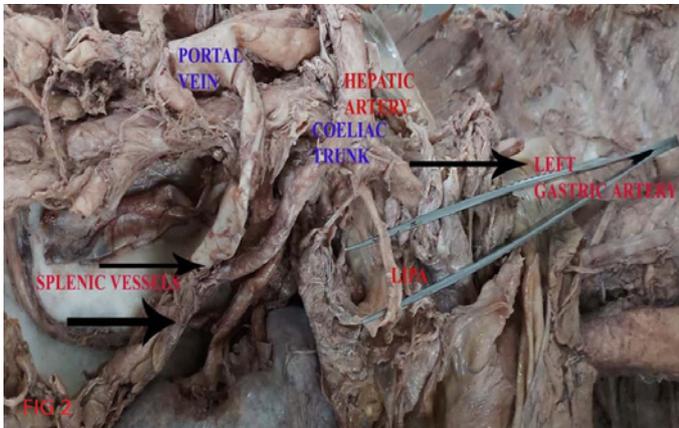


Figure 2. Left inferior phrenic artery (LIPA) from celiac trunk

Discussion

Vascular variations were common in humans and were overlooked because of lack of obvious clinical symptoms but later observed during dissection of cadavers and then correlating its cause with its development. Also present case report correlated the variation with its effect on associated clinical condition. Several authors reported these variations. According to Nayak SR LIPA took origin from the coeliac artery as its first branch, other than its four usual branches⁵. In another study done by

Pulakunta T LIPA showed a variant origin in four out of 32 cases. In two cases it arose directly from the celiac trunk, one from left gastric artery and another from the right renal artery⁶. A study done by B Akhilandeswari and P Ranganath in 32 Cadavers RIPA arose from aorta in 53.125%, celiac trunk in 18.75%, renal artery in 18.75% and superior mesenteric artery in 6.25% cases. LIPA arose from aorta in 50%, from celiac trunk in 37.5% and 12.5% from the renal artery⁷. According to a case studied by Faria LAM *et al* RIPA arose from right renal artery⁸. Banani kundu *et al* reported a case of RIPA arose from right renal artery⁹. In all of above studies the origin of RIPA from renal artery is third common source after aorta and celiac trunk. The origin of left inferior phrenic artery from celiac trunk is second common source after aorta. Since our case is a single case so not in a position to support the frequency of origin from various sources as quoted in previous literature. But the finding in present case definitely concurs with previous authors finding. This vascular variation could be explained by its embryological basis that every anomaly in the vascular anatomy could be

related to its genesis, regression or persistence of one or other segment of the embryologic artery. Inferior phrenic artery is said to be formed by the persistent superior artery of irregular series of arterial vessels called Rete arteriosus urogenitale¹⁰. The importance of the RIPA is not limited to the treatment of HCC. Practically any hepatic growth including metastatic disease to the liver may receive blood supply from the RIPA¹¹. As inferior phrenic artery can also arise from renal or supra renal arteries, due care should be taken to avoid ligating it during the surgeries involving kidneys and adrenal glands¹². The IPA 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 (e.g Mallory-Weiss tear and gastroesophageal cancer) may also be related to the IPA¹³. The LIPA gives collateral supply to stomach in case of gastric arterial occlusion. So during a TACE procedure, gastric and esophageal damage could occur if non target embolisation is done. Information about inferior phrenic artery variations is necessary to avoid unintentional sectioning of these small calibre arteries, as it may be seen during decompression in compression syndrome of the celiac trunk by the median arcuate ligament¹⁴.

Conclusion

The anatomical knowledge of possible variations of inferior phrenic artery origin are essential to gastroenterologists and oncologists. Abdominal surgeries without proper knowledge of possible variations of this artery can lead to iatrogenic dissection. Their possible involvement in hepatic neoplasms also justifies its importance for post-surgical prognosis.

Abbreviations

HCC – Hepatocellular carcinoma
LIPA – Left inferior phrenic artery
RIPA – Right inferior phrenic artery
TACE – Transcatheter arterial chemoembolization

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