



Multiple variations in the branching pattern of abdominal aorta

Published online July 21st, 2014 © <http://www.ijav.org>

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Received July 15th, 2013; accepted April 2nd, 2014

Abstract

Multiple variations of the branches of abdominal aorta were observed during a routine dissection of the abdominal region in a 60-year-old male cadaver in the Department of Anatomy, Government Medical College, Latur.

In the present case, both inferior phrenic arteries arose from the coeliac trunk, and then coeliac trunk continued as common hepatic artery, after a short course of about 2.5 cm it gave gastric trunk which divided into right and left gastric arteries. Splenic artery arose from the superior mesenteric artery.

Right renal artery arose 1 cm below the left renal artery. Left testicular artery arose from anterolateral aspect of aorta 1 cm below the left renal artery, right testicular artery branched from anterior aspect of aorta 2.5 cm below the left testicular artery.

Inferior mesenteric artery arose from the aorta 7.5 cm below the superior mesenteric artery. Abdominal aorta bifurcated into right and left common iliac arteries at the level of L4 vertebra.

Knowledge of these variations could help surgeons to identify and protect the branches of abdominal aorta during surgery and radiological investigation.

© *Int J Anat Var (IJAV)*. 2014; 7: 86–88.

Key words [aortal] [coeliac trunk] [renal] [phrenic] [testicular] [splenic artery]

Introduction

The abdominal aorta (AA) begins at the aortic hiatus of the diaphragm at the level of 12th thoracic vertebra. It descends anterior to the lumbar vertebrae to end at the lower border of the fifth lumbar vertebra by dividing into right and left common iliac arteries. The branches of abdominal aorta are grouped into anterior, lateral and dorsal branches. The coeliac trunk (CT) is the first anterior branch of abdominal aorta and it arises from the abdominal aorta immediately below the aortic hiatus at the level of T12-L1 vertebrae. The left gastric, splenic and common hepatic arteries all arise from coeliac trunk. Superior mesenteric artery (SMA) originates 1 cm below the coeliac trunk, at the level of the L1-L2 intervertebral disc [1].

The inferior mesenteric artery (IMA) arises from the anterior or anterolateral aspect of the AA at the level of the L3 and 3-4 cm above aortic bifurcation. Inferior phrenic artery arises separately from the anterior aspect of the AA, just above the CT. Testicular arteries (TA) arise inferior to the renal artery (RA) [1].

Variations in AA and its branches are frequently observed and they occur due to embryological developmental changes.

Knowledge of morphology of AA and its branches is important in regards to renal transplantation, renal trauma surgery,

radiological imaging. Variations of the branches of AA and their relations to surrounding structures are important in regards to abdominal surgery. The arteries that show frequent variations include CT, SMA, RA and TA [2].

Although these variations might encounter in different cadavers, it is rare to find all these variations in the same cadaver.

Case Report

During the dissection of abdomen for the first year MBBS students at Government Medical College, Latur, we found multiple variations in the branching pattern of AA.

The following variations of branches of AA were observed:

1. The inferior phrenic arteries arose from the coeliac trunk.
2. Coeliac trunk after giving origin to inferior phrenic artery, continued as a common hepatic artery, after a course of about 2.5 cm it gave common gastric arteries.
3. Common hepatic artery divided into gastroduodenal, right hepatic and left hepatic arteries.
4. Splenic artery arose from superior mesenteric artery.
5. Left renal artery arose from aorta at the level of superior mesenteric artery; right renal artery arose from abdominal aorta 1 cm distal to renal artery.

6. Left testicular artery arose from aorta 1 cm distal to the left renal artery; right testicular artery arose from anterior aspect of aorta, 2.5 cm distal to left testicular artery.
7. Inferior mesenteric artery arose from aorta about 7.5 cm distal to superior mesenteric artery.
8. Superior and middle suprarenal arteries were absent (Figure 1).

In this case, vertebral level of various arteries was as follows.

1. Coeliac trunk – L1
2. Superior mesenteric artery – intervertebral disc between L1-L2.
3. Left renal artery – intervertebral disc between L1-L2.
4. Right renal artery – middle of L2.
5. Left testicular artery – upper border of L2.
6. Right testicular artery – middle of L3.
7. Inferior mesenteric artery – upper border of L4.
8. Bifurcation of aorta – lower border of L4.

In the present case we discuss about the embryological basis for these variations of abdominal aorta and its clinical importance.

Discussion

The multiple variations in the branching pattern of AA has embryological basis.

The yolk sac is supplied by a number of paired vessels called omphalo-mesenteric or vitelline or ventral splanchnic arteries at the end of 4th week of intrauterine life [3]. These vessels gradually fuse in the later part of the embryonic life and in the dorsal mesentery of the gut they form the arteries which in adult life are represented as the CT, SMA and IMA. Defective fusion of these ventral splanchnic arteries during the embryonic stage can be an important factor manifesting as the anatomical variations observed in CT and SMA [3].

Normally inferior phrenic artery is the branch of AA just above the CT [1]. The inferior phrenic arteries originated with almost equal frequency from the CT as well as directly from the AA, thus reported an incidence of 39.7% and 38.6%, respectively [4]. The precise localization of the inferior phrenic artery is significant to control effectively hepatocellular carcinoma by transcatheter arterial chemoembolization and during transarterial embolization in patients with severe hemoptysis [4].

The typical trifurcated type of the CT has a frequency of 84-86% [5]. If one of the main branches is absent, a gastrosplenic trunk (with absence of hepatic artery, 5-6%) and hepatogastric trunk (with absence of splenic artery, 6%) are found. If two main branches are absent then the three main branches originate independently, there is no real CT.

In the present case splenic artery arises from the SMA, the reported incidence of origin of splenic artery from SMA is 1% [6].

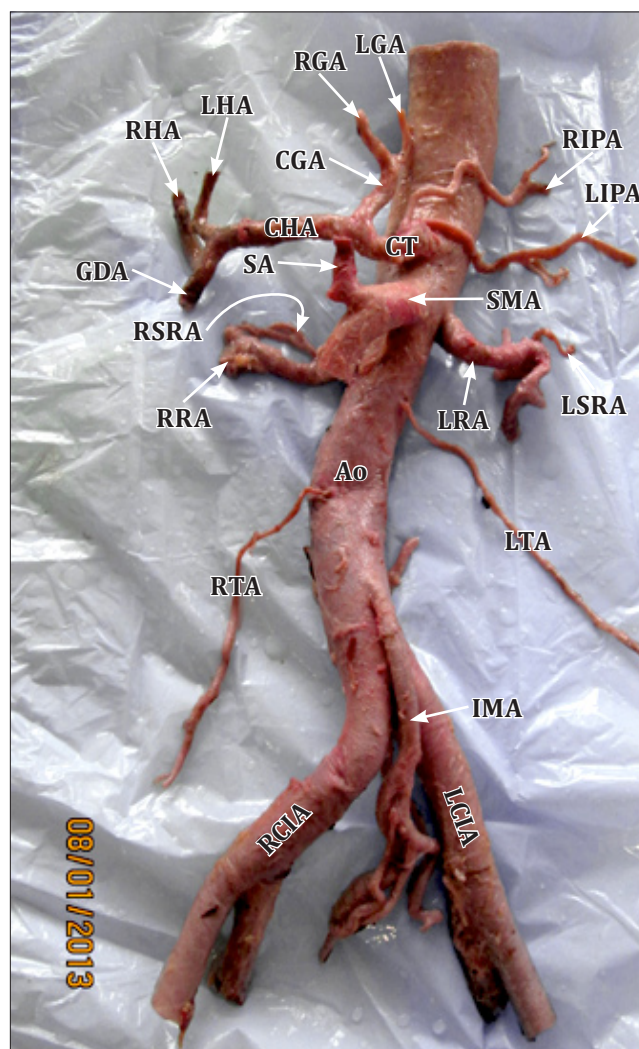


Figure 1. Picture showing branches of abdominal aorta. (Ao: aorta; CT: coeliac trunk; RIPA: right inferior phrenic artery; LIPA: left inferior phrenic artery; CGA: common gastric artery; RGA: right gastric artery; LGA: left gastric artery; CHA: common hepatic artery; RHA: right hepatic artery; LHA: left hepatic artery; GDA: gastroduodenal artery; SMA: superior mesenteric artery; SA: splenic artery; RRA: right renal artery; LRA: left renal artery; RSRA: right suprarenal artery; LSRA: left suprarenal artery; RTA: right testicular artery; LTA: left testicular artery; IMA: inferior mesenteric artery; RCIA: right common iliac artery; LCIA: left common iliac artery)

The RAs are the lateral branches of the AA and originated from the aorta just below the SMA. The right RA is larger and usually originates slightly higher than the left [1]. However, some studies reported that both arteries originated at the same level from aorta [7]. In the present case, left RA originates 1 cm higher than the right RA at the level of superior mesenteric artery.

The high origin of TA is due to the reason that the TAs are derived from nine lateral mesonephric arteries in the 18 mm embryo. Typical TAs derived from the caudal branches

while origin is near to the CT, suggest the origin from cranial branches [7]. In the present study the left TA is higher than right, about 2 cm below the CT, which may be derived from middle group of lateral splanchnic artery and right TA, may be derived from the caudal group of lateral splanchnic artery [7]. The high origin of TA may be responsible for hemodynamic insufficiency in kidney and gonads while the decreased blood may lead to varicocele and testicular atrophy [7].

In the present case, superior and middle suprarenal arteries were absent. The suprarenal gland is supplied by a branch from RA (inferior suprarenal artery). Also IMA originated from anterolateral aspect of aorta 7.5 cm distal to sma that may be due to defective fusion of ventral splanchnic arteries [3].

The combination of multiple variations in the branching pattern of the AA presented in this study to our best knowledge is unique in the literature.

Conclusion

The arterial variations as noted in the present study should not be ignored during abdominal operative procedures. Many complications could be avoided with the accurate knowledge of such arterial variations of branches of AA. Knowledge of such variations will play a significant role in carrying out surgical interventions safely in the abdomen and also in the interpretation of angiographic reports. Vascular variations can also become a technical problem for infusion therapy and chemoembolization of neoplasm in the liver.

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