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Unusual branching pattern of celiac trunk associated with supernumerary hepatic arteries and abnormal adrenal venous drainage — case study and review of the literature

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Abstract: Celiac artery (trunk) is one of the three major arteries which arise from abdominal aorta. It's variations not seem to be very uncommon. A routine dissection of a male cadaver at Department of Anatomy Jagiellonian University revealed unusual branching pattern of the celiac trunk with numerous supernumerary hepatic arteries. Additionally unusual venous drainage of the adrenal glands was found. A review of current literature has shown that a changed branching pattern may be important from clinical point of view, with special respect to endovascular procedures, laparoscopic surgery or radiology.

Key words: anatomical variation, celiac trunk, supernumerary hepatic arteries, adrenal veins.

Introduction

Coeliac trunk is an artery which belongs to major single branches of abdominal aorta. It usually originates slightly below the diaphragm opposite the intervertebral disk T12/L1. Normally it supplies abdominal portion of the esophagus, the stomach and the upper duodenum, the liver, the gallbladder and the extrahepatic biliary tracts, the spleen and the majority of the pancreas. Anatomical variants of the coeliac trunk (artery) and its further subdivisions were the object of numerous morphological and dissection studies. Its length varies from 15–30 mm. To the most frequent branches belong: common hepatic (widely known in English literature as hepatic artery), splenic and left gastric. Although through years numerous studies reported significant variation of this vessel, i.e. in the form of double, triple or quadruple branching pattern with some unusual arteries which originate from it [1].

From the times of Vesalius, von Haller and Winslow numerous anatomical variations have been described. Although the artery has been denoted long time ago, among others by Galen and Vesalius (Vesalius supposed that coeliac artery is divided into right and left branches of which right supplies the liver and the left goes toward the spleen), the proper description was left by Albrecht von Haller (1708–1777). To commemorate his work coeliac artery has been named for long time as a "Haller's tripod". Von Haller, Monro, Albinus and Cheselden contributed by their several treatises to render anatomy still more precise as a descriptive science [2].

Development of endovascular techniques, i.e. embolization techniques requires more and more current data necessary for performing procedures — both by vascular surgeons and intervention radiologists. Knowledge on variations of the coeliac trunk in these specializations is indispensable and prerequisite for planning such procedures [3].

Also current transplantology techniques require deep anatomical knowledge on the blood supply of different organs with special attention to abdominal and pelvic regions of the human body [4].

Most of variations (around 86%) include three main branches of the coeliac trunk: left gastric, common hepatic and splenic arteries which arise from abdominal aorta as common trunk (coeliac trunk or hepatogastrolienal trunk). Following studies of Adachi left gastric artery may originate directly from the abdominal aorta in about 8% of population. In these cases common hepatic and splenic arteries arise as hepatolienal trunk. Quite rarely (about 1%) left gastric arises from abdominal aorta alone while the rest of coeliac trunk branches unite with the superior mesenteric artery (hepatosplenomesenteric trunk). Sometimes all three branches of the coeliac trunk unite with the superior mesenteric artery forming (1.5%) coeliacomeseteric trunk. In about 0.5% left gastric unites with the splenic and they form gastrolienal trunk while the next vessel arises from the abdominal aorta and it consists of the common hepatic and superior mesenteric arteries (hepatomesenteric trunk). In 3% gastrolienal

trunk persists while the liver is supplied by the supernumerary hepatic arteries which may arise from different, sometimes unusual sources. We strongly agree with the authors who postulate measurements of the distance between the coeliac trunk and the superior mesenteric artery. Besides the data on the origin of the accessory hepatic arteries seem to be quite scanty [1].

Arterial system is quite variable, but no more than venous system [5]. Numerous papers deal with the variations of the venous system. In our paper we would like to focus on the special variation of the celiac trunk with additional supernumerary hepatic arteries and abnormal drainage of the suprarenal veins observed during a routine section of a male cadaver [6].

Materials and methods

A 67-year-old male cadaver for subjected to routine anatomic dissection in the Department of Anatomy, Jagiellonian University Medical College. The cadaver was fixed in a 10% formaldehyde solution. It had no traces of surgical procedures in abdominal region. The study was carried out with classical dissection techniques. During the prosection anterior abdominal wall was classically opened in the median sagittal plane with the incision on the left side of umbilicus to spare round ligament of the liver. Subsequently two incisions which paralleled anterior costal margins, were made. Lesser omentum was gently dissected to visualize origin of the coeliac trunk, its branches and their further subdivisions. Next the parietal peritoneum from posterior abdominal wall was removed. Both kidneys were exposed together with the renal veins and inferior vena cava. Origin of the superior mesenteric artery was found also. We paid much attention to gentle dissection of the renal veins and their tributaries, especially on the left. Extrahepatic biliary tracts were partially exposed to visualize the course of accessory hepatic arteries found. All specimens were next photographed using binocular operation microscope Karl Zeiss Surgical GmbH Operation 100 xenon and attached camcorder Kamera Sony 8 Mpx with lens microscope with focal length f:300 and eye-piece focal length f:170.

Results

In the cadaver studied we found the following:

1. celiac trunk which originated from the abdominal aorta opposite L1, divided into two major branches: common hepatic and splenic arteries.
2. left gastric artery originated from the celiac trunk independently on two remaining vessels and it gave off the accessory hepatic artery.
3. the common hepatic artery ran above the head of pancreas and divided into gastroduodenal and proper hepatic arteries.

4. proper hepatic artery was very small and rudimentary.
5. co-occurrence of two accessory hepatic arteries — the next arose from the superior mesenteric artery (Fig. 1).
6. normally the left adrenal vein empties into the left renal, while in our cadaver it drained into the inferior vena cava directly. It was connected to the left renal vein by a narrow delicate vascular shunt (Fig. 1 and 2).

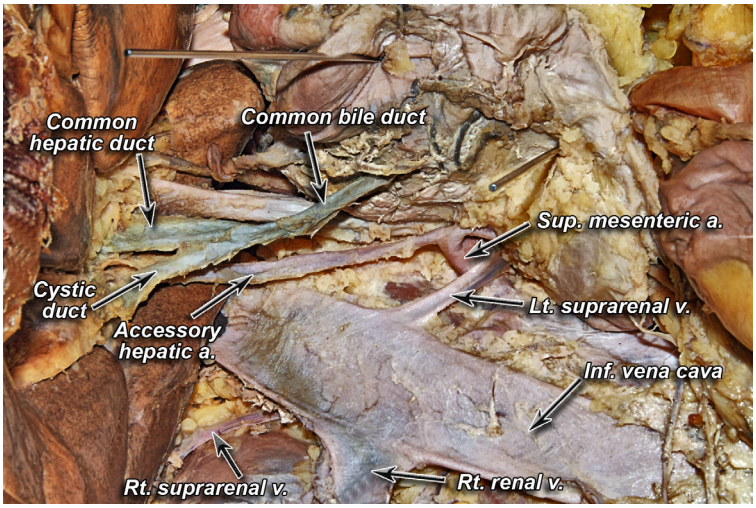

Fig. 1. Accessory hepatic artery arising from the superior mesenteric. Left suprarenal vein empties into inferior vena cava directly.

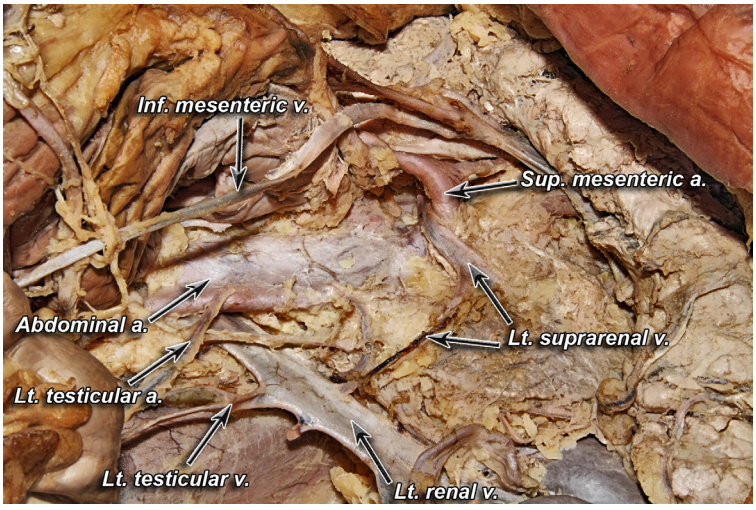

Fig. 2. Delicate vascular connection between the left renal and left suprarenal veins.

Next, after gentle dissection we have removed the intestines together with the superior mesenteric artery and the stomach with the coeliac artery. Fragments of these vessels were preserved. We found both inferior phrenic arteries arising from the coeliac trunk directly (Fig. 3–5).

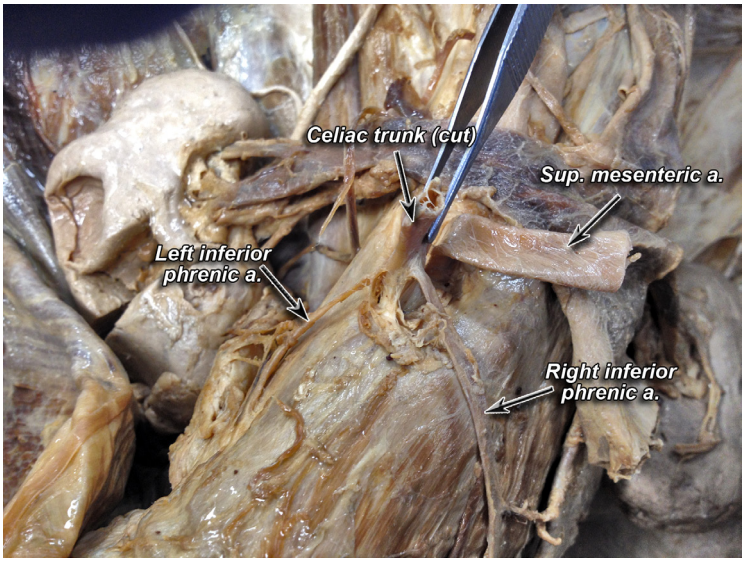

Fig. 3. Inferior phrenic arteries arising from the coeliac trunk.

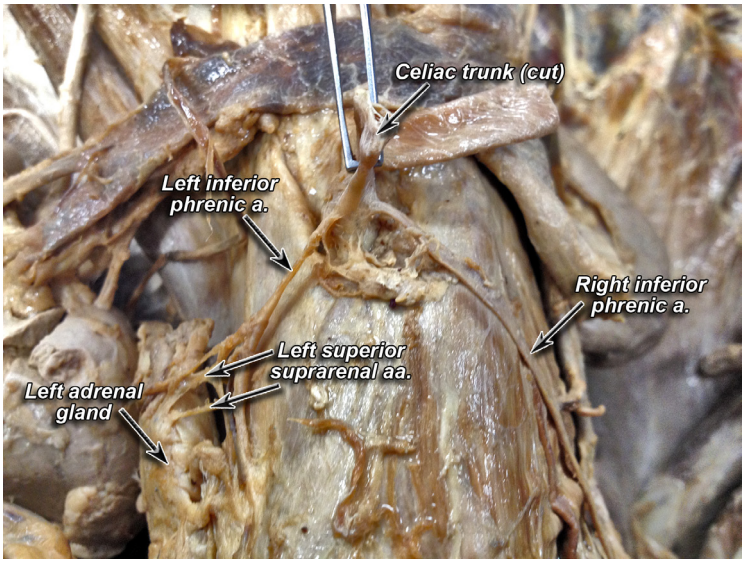

Fig. 4. Inferior phrenic arteries arising from the coeliac trunk (cut). Left superior suprarenal arteries.

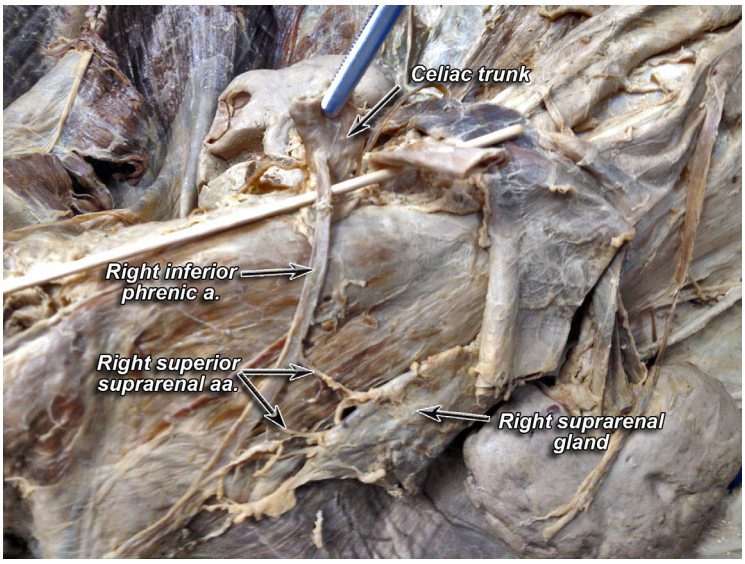

Fig. 5. Inferior phrenic arteries arising from the coeliac trunk (cut). Superior suprarenal arteries arising from the right inferior phrenic artery.

Discussion

Based on the branching pattern several classifications on the coeliac trunk have been presented so far. Adachi was one of the first who created own classification in 1928 although it seems that first report and attempt to classification was made by Lipshutz in 1917, however it seems that his study wasn't based on a group large enough [1, 7].

Only during last three years several complex studies arose which were associated with new proposals of classifications of different variants of the celiac trunk [7–14].

The bigger study group is results seem to be more relevant. I.e. Song *et al.* studied over 5000 patients and found normal trifurcation in almost 90% of cases [15]. This results is close to Adachi's observation who found this pattern in 86% of cases [1]. Also Araujo-Neto found this variant in 90% of patients [8].

Babu and Khrab tried to create new classification of the coeliac trunk [16]:

1. Normal trifurcation;
2. Hepatosplenic trunk;
3. Hepatogastric trunk;
4. Gastrosplenic trunk;
5. No celiac trunk;
6. Celiacomesenteric trunk;
7. Hepatomesenteric trunk;
8. Gastromesenteric trunk;

9. Splenomesenteric trunk;
10. Hepatosplenomesenteric trunk;
11. Gastrosplenomesenteric trunk;
12. Coeliaccolic trunk;
13. Coeliophrenic trunk (CT+CIPA);
14. Coeliophrenic trunk (CT+RIPA);
15. Coeliophrenic trunk (CT+LIPA).

Several new types have been added to this classification by Olewnik *et al.* who also reviewed previous classifications [17].

In our case, we observed accessory hepatic arteries. It was Hiatt [18] *et al.* and Michels [19] who proposed detailed classifications on the origin and branching pattern of accessory hepatic arteries. Accessory left hepatic artery originating from the left gastric artery and accessory right hepatic artery originating from the superior mesenteric artery in Michels' classification referred to Type VII. However this classification says nothing on the origin of the third artery which is a continuation of the proper hepatic artery.

Numerous studies have been performed on the vasculature of adrenal gland (including fetal) [20]. However coincidence of the accessory hepatic arteries and abnormal drainage of the left adrenal gland seems to be quite rare. Especially during laparoscopic procedures possible sectioning of accessory hepatic artery may lead to severe bleeding, hypovolemic shock and finally decease.

Conflict of interest

None declared.

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