CASE REPORT

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Anatomical variations of the hepatic portal vein associated with incomplete celiac trunk

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Abstract

An association of two anatomical variations was revealed in a 65-year-old male cadaver: the first variation concerns the forming of the trunk of the hepatic portal vein, while the second concerns the branches of the celiac trunk. In this case, the inferior and superior mesenteric veins form a common trunk that is further united with the splenic vein and gives rise to the hepatic portal vein. At the same time, the existence of an incomplete (branched) celiac trunk was revealed, the hepatosplenic trunk from which the common hepatic artery and the splenic artery arise; the left gastric artery arises separately at 0.5 cm superolaterally from the origin of the celiac trunk. Familiarity with this anatomical variation provides useful information for abdominal surgery procedures.

Keywords: anatomical variations, hepatic portal vein, celiac trunk, hepatosplenic trunk.

Introduction

The hepatic portal vein (*Vena portae hepatis*) is responsible with the functional circulation of the liver. It collects venous blood from the infradiaphragm part of the digestive tube (to the level of the inferior part of the rectal ampulla), the pancreas, the spleen and extra-hepatic biliary tract, the peritoneum and the abdominal lymph nodes and circulates about 1–1.2 L blood/minute through the liver [1].

Characteristically, the hepatic portal vein arises from the right-angle union of the superior mesenteric vein (a satellite of the homonymous artery, with a vertical ascending direction) with a common venous trunk of horizontal direction, called the splenic-mesenteric trunk, formed by the confluence of the splenic vein with the inferior mesenteric vein.

The portal confluence is located at the level of upper border of the second lumbar vertebra, sometimes at the level of the inferior border of the body of the first lumbar vertebra, right paramedially, anterior to the inferior vena cava and posterior to the pancreatic neck (in the middle or closer to its superior border) [2–6].

The three venous trunks unite in different ways [7] quoted by [8] describes four morphological types of forming the trunk of the hepatic portal vein, according to the type of confluence of the original branches.

The tract of the hepatic portal vein trunk varies with the angle it forms with the vertical plane. Three types of tract are described:

- The oblique tract is the most common (60% of cases); the trunk of the hepatic portal vein makes an angle of 45^0 with the vertical plane;
- The vertical tract (35% of cases); the trunk of the hepatic portal vein makes an angle of $10–30^0$ with the vertical plane;
- The horizontal tract (35% of cases); the trunk of the hepatic portal vein makes an angle of $75–80^0$ with the vertical plane.

The celiac trunk (*Truncus coeliacus*) is the first collateral visceral branch of the abdominal aorta. First described by Haller in 1756 and known as Haller's celiac tripod, the celiac trunk gives rise to its terminal branches: the left gastric artery, the common hepatic artery and the splenic artery. The celiac trunk supplies blood to the esophagus, stomach, spleen, liver, biliary tract and part of the duodeno-pancreatic complex and epiploons.

A three-branched medial artery, the celiac trunk arises from the anterior part of the abdominal aorta and is positioned inferior to the aortic hiatus of the diaphragm, between the two diaphragm pillars, at the level of the $T_{12}–L_1$ intervertebral disk, sometimes at the level of the superior border of the first lumbar vertebra.

Materials and Methods

The routine dissection of a 65-year-old male cadaver performed in the Laboratory of the Anatomy and Embryology Department of the "Victor Babeş" University of Medicine and Pharmacy, Timişoara, revealed two vascular variations, one concerning the formation of the hepatic portal vein trunk and the other revealing the presence of an incomplete celiac trunk (hepatosplenic trunk).

Results

In the presented case, the inferior mesenteric vein (IMV) (0.4 cm in diameter) opens on the left side of the

superior mesenteric vein (SMV), forming a very short common trunk that runs in the direction of the superior mesenteric vein, ascending obliquely to the left. The common trunk is 0.6 cm long and 1.7 cm in diameter (Figure 1).

The splenic vein (SV) is 11.9 cm long and 0.74 cm in diameter. It unites with the common trunk of the two mesenteric veins and gives rise to the trunk of the hepatic portal vein (PHV), which is 6.5 cm long and 2.2 cm in diameter.

The tract of the portal vein trunk continues the tract of the splenic vein, ascending obliquely to the right. The angle between the portal vein trunk and the splenic vein measures 148^0, while the angle between the portal trunk and the superior mesenteric vein measures 91^0 (Figure 2).

The examination of the celiac trunk has revealed the presence of a common hepatosplenic trunk (HST) originating on the anterior part of the abdominal aorta, near the T_{12}–L_1 intervertebral disk. The common hepatosplenic trunk ascends obliquely to the right and after a tract of about 1.6 cm ends in two branches: the common hepatic artery (CHA) and the splenic artery (SA). The trunk is 0.6 cm in diameter (Figure 3).

The left gastric artery (LGA) originates separately in the anterior part of the abdominal aorta, superior and to the left of the celiac trunk origin. The artery measures 0.3 cm in diameter (Figure 4).

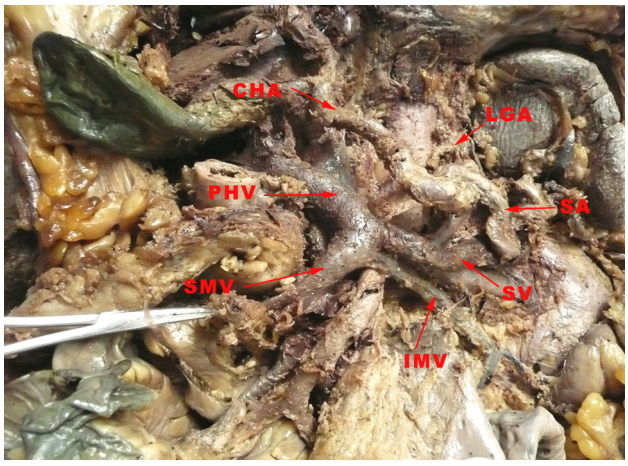

Figure 1 – ***Original tributaries of the hepatic portal vein trunk.***

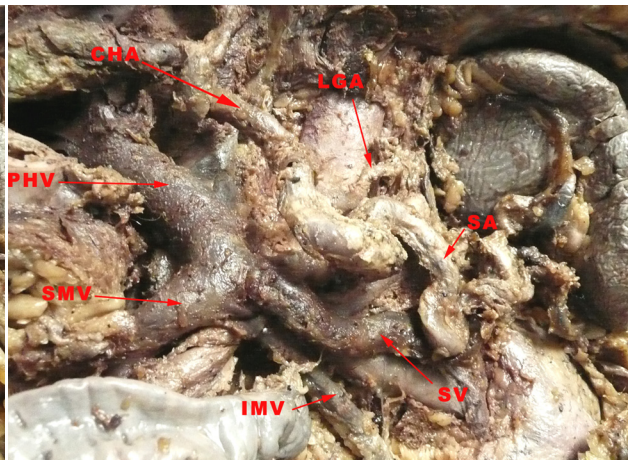

Figure 2 – ***The tract of the portal vein trunk.***

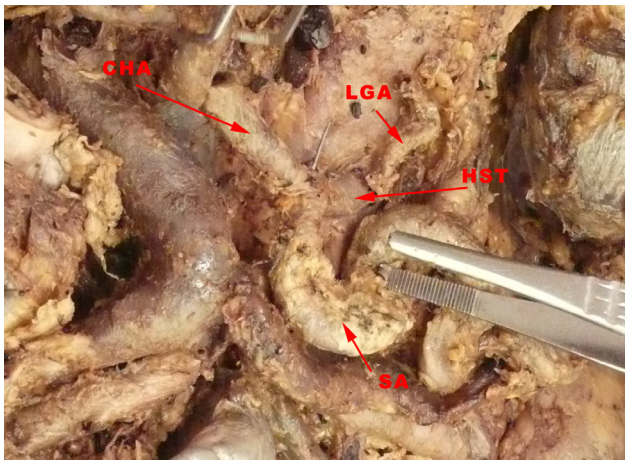

Figure 3 – ***The hepatosplenic trunk.***

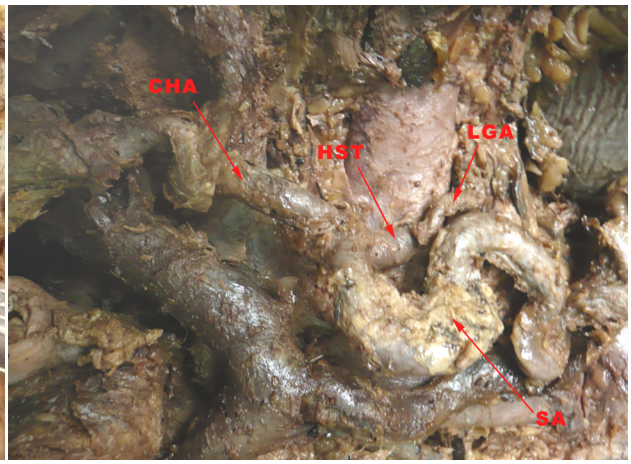

Figure 4 – ***The origin organic the left gastric artery.***

Discussion

The literature includes many studies concerned with the forming of the hepatic portal vein. Couinaud C [7], quoted by [8], describes four types of forming the hepatic portal vein trunk according to confluence of the three original veins:

- Type I: the splenic vein forms a common trunk with the inferior mesenteric vein that further unites with the superior mesenteric vein;
- Type II: the two mesenteric veins form a common trunk that unites with the splenic vein;
- Type III: the tripod convergence, in which the three veins unite and form the trunk of the hepatic portal vein;
- Type IV: the inferior mesenteric vein confluences both with the splenic vein and the superior mesenteric vein.

Von Lanz T and Wachsmuth W [1] analyses the four types of the flow of the inferior mesenteric vein based on the studies developed by Walcker FJ [9] and Hähndel-Schwerdtfeger M [10]. The Hähndel-Schwerdtfeger's study [10] reports that the inferior mesenteric vein flows in the superior mesenteric vein only in rare cases (18% of cases). Of these, 53% were described by Alexander WF and Purcell HK [11].

Chevrel JP [8] sums up the studies dealing with how the hepatic portal vein is formed and underlines the

frequency of the first three types (type IV is ignored). Type I is the most common. A number of studies have reported that type II, to which the case we present belongs, has the following incidence: 24% [12], 29% [5], 29.3% [2], 45.5% [13], 53% [14]. Von Lanz T and Wachsmuth W [1] reported an average incidence of type II of 32.4%, while Chevrel's statistics [8] indicated 36.16%.

Another particularity of the case presented in this paper is the tract of the hepatic portal vein trunk in relation to the tract of the superior mesenteric and splenic veins.

Most frequently, the portal vein trunk continues the tract of the superior mesenteric vein. In our case, it takes a different direction and forms a 91^0 angle with the vein.

Terminologia Anatomica [15] homologates the inferior mesenteric vein as a tributary of the splenic vein. As a result, the confluence angle between the splenic vein and the superior mesenteric vein measures 90^0.

In our case, the angle of the two veins is 121^0, and the trunk of the hepatic portal vein continues the tract of the splenic vein and forms a 148^0 angle with it.

The convergence angles between the superior mesenteric vein, the splenic vein and the portal vein trunk were measured by Papadopoulos NJ [12], who found the following values:

- The angle formed by the hepatic portal vein with the vertical plane varies between $10–50^0$ (a mean of 29^0);
- The angle formed by the splenic vein and the portal vein trunk varies between $90–140^0$ (a mean of 113^0);
- The angle formed by the superior mesenteric vein and the splenic vein varies between $75–130^0$ (a mean of 96^0).

In our case, the angle formed by the portal vein trunk and the vertical plane was 148^0, belonging to the oblique type. A branched celiac trunk (hepatosplenic trunk) was also revealed, and the left gastric artery had a different origin in the abdominal aorta, superior and to the left of the common trunk.

The morphological variations of the celiac trunk described in the literature can differ in origin, tract, diameter and number of terminal branches. The incidence and morphological variations of the celiac trunk have been the subject of numerous anatomical and clinical studies.

Following a study performed on over 200 cadavers, Michels NA [16] describes and classifies 10 morphological types of anatomical variations of the celiac trunk according to the origin and number of terminal branches. This study reported an 11% incidence of branched celiac trunk.

Vandamme JP and Bonte J [17] published a study about 156 angiograms performed post mortem and describe the occurrence of the branched celiac trunk in 13.5% of cases.

On analyzing the morphology of the celiac trunk based on the data in the literature, Yi SQ *et al.* [18] indicate that in 87.6% of cases there is a complete trunk (three branches); in 12.2% of cases the trunk is incomplete (two branches) and its absence is very rare (0.2%). The first case of absence of the coeliac trunk was reported in 1832 by Geoffroy Saint-Hilaire, quoted by Okada S *et al.* [19].

The development of angiographic medical imaging has facilitated the study of the vascular variations and has allowed a complex pre-operatory evaluation and the extension of surgical procedures.

Iezzi R *et al.* [20] performed an angiographic evaluation of the anatomic variations of the celiac trunk on 524 cases. The classified the variations applying Michels's criteria. The branched variations they found in the studied material were: hepatosplenic trunk (2.7%), hepatogastric trunk (5%) and gastrosplenic trunk (3.6%)

In the common hepatosplenic trunk, the left gastric artery arose separately from the abdominal aorta. The presence of the hepatogastric trunk was associated with the splenic artery arising either from the abdominal aorta or the superior mesenteric artery. In the case of gastrosplenic trunks, the common hepatic artery arose either from the abdominal aorta or from the superior mesenteric artery.

Covey AM *et al.* [21] studied the morphological variations of hepatic artery vascularisation on 600 angiographies and reported that the left gastric artery originated from the abdominal aorta (3.5%), from the gastrolienal trunk (2%) and from the gastrophrenic trunk (1%).

Silveira LA *et al.* [22] measured the diameters of the trunk and its main branches and summed up the results of the previous studies on the celiac trunk in the literature. The average diameter of the celiac trunk was 0.79%, comparable with the value of 0.8 cm data specified in the literature. The authors found equal percentages (4.8%) of incomplete celiac trunk (hepatosplenic and gastrosplenic), but they did not measure the trunks.

The average diameter organic the left gastric artery was 0.38 cm, slightly higher than the values specified in the literature.

In our case, the diameter of the hepatosplenic trunk was 0.6 cm (smaller than the normal celiac trunk, which is explained by the existence of only two terminal branches) and the left gastric artery was 0.3 cm, a value that is close to the one specified in other studies.

Conclusions

Familiarity with the anatomical vascular variations is of clinical importance in abdominal surgery and oncological and imagistic procedures.

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