An Anomalous Case of the Hepatic Artery Arising from the Superior Mesenteric Artery

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Summary: In a student course of gross anatomy dissection at Kanagawa Dental College in 2006, we found an extremely rare case of the hepatic artery arising from the superior mesenteric artery of a 78-year-old Japanese male cadaver. This case belonged to type V in Adachi’s classification of the celiac trunk and the superior mesenteric artery (1928). The gastro-splenic trunk and hepato-mesenteric trunk both arose from the abdominal aorta and the left gastric artery arose from the gastro-splenic trunk. The hepatic artery arose from the hepato-mesenteric trunk and crossed the portal vein anteriorly.

The left gastric artery, splenic artery, and common hepatic artery normally arise from the celiac artery, and the superior mesenteric artery arises directly from the abdominal aorta. Adachi classified the patterns of ramification of the celiac trunk into six types and showed diversity within each pattern (Fig. 1).

According to Adachi’s classification, anomalies in which the hepatic artery arises from the hepato-mesenteric artery and passes anterior to the portal vein belong to Type V. In this classification, Type V anomalies were found in 0.4% of 252 Japanese specimens, and thus they are a rare anomalous case.

It is said to be necessary to take the branching pattern of these blood vessels into consideration when performing hepatic and pancreatic surgery, and thus knowledge of anomalous arterial branching patterns is important from the standpoint of surgical anatomy. During a routine dissection for students at Kanagawa Dental College, we encountered a hepatic artery that arose from the mesenteric artery and belonged to Type V in Adachi’s classification, we report the case of this type of anomaly.

Findings

This was a case of a 78-year-old Japanese male who died from cardiac insufficiency. In this subject, the main branches directly arising from the abdominal aorta and distributed to the digestive organs: a common trunk of the splenic artery and left gastric artery (the gastro-splenic trunk) and a common trunk of the hepatic artery and superior mesenteric artery (the hepato-mesenteric trunk) (Fig. 2).

The Gastro-splenic Trunk

The gastro-splenic trunk arose from the anterior wall of the abdominal aorta. Its external diameter at its origin was 6.2 mm, and it reached the spleen by coursing along the superior margin of the pancreas. The splenic artery runs meanderingly through the surface of the pancreas to the spleen. Along its course the splenic artery gave off several branches to the body and tail of the pancreas. There were a branch that run to the right side of the pancreas. It arose from the gastro-splenic trunk 25.3 mm distal to the origin of the gastro-splenic trunk, and its external diameter at its origin was
2.6 mm. The left gastric artery arose from the gastro-splenic trunk 27.2 mm distal to the origin of the gastro-splenic trunk. Its external diameter at its origin was 3.8 mm, and it supplied the lesser curvature of the stomach.

The Hepato-mesenteric Trunk

The hepato-mesenteric trunk arose from the anterior wall of the abdominal aorta 14.0 mm distal to the origin of the gastro-splenic artery. The external diameter of the trunk at its origin was 8.9 mm, and after coursing anteriorly for 24.7 mm, it bifurcated into the common hepatic artery (external diameter at its origin: 6.3 mm) and the superior mesenteric artery (external diameter at its origin: 6.6 mm). The common hepatic artery coursed superioly and laterally, and after passing anterior to the portal vein, it gave off the gastroduodenal artery (external diameter at its origin: 4.4 mm) 30.4 mm distal to its origin. After the gastroduodenal artery branches off, the common hepatic artery is called the proper hepatic artery (external diameter at its origin: 5.4 mm). The proper hepatic artery divided into a left branch and right branch 15.0 mm distal to its origin (Fig. 3).

Discussion


According to these reports Type V pattern in Adachi's classification was found in 0.4% of 252 specimens (1 case, Adachi, 1928), 1.9% of 107 specimens (2 cases, Imakoshi, 1949), 2.0% of 450 specimens (9 cases, Shoumura, 1991), and 0.7% of 275 specimens (2 cases Sato, 1993). The incidence of Type V is not stable, but this type is a rare case of an arterial anomaly in the celiaco-mesenteric region. The embryological discussion that related to the anomaly of the celiaco-mesenteric artery were made by Tandler (human embryo, 1904), Morita (human adult, 1935), Wustinger (sheep, 1978), and Sato (human adult, 1993). Morita reported that anomalies of the pattern of ramification of the celiaco-mesenteric artery were affected by dis-
appearance of the roots of the primitive ventral splanchnic arteries (PVSA) and the anastomotic arteries of the PVSA.

According to Morita’s hypothesis, our case is a result of disappearance of the 3rd root, which corresponds to the common hepatic artery. The gastro-splenic trunk was formed by the 1st root, 2nd root, and the longitudinal anastomotic artery. Because of the disappearance of the 3rd root, the hepato-mesenteric trunk may have been formed by the superior mesenteric artery and the hepatic artery branching off the 4th root, which corresponds to the superior mesenteric artery.

Sato considered about the pattern of ramification of the celiac-mesenteric arteries based on Tandler’s embryological explanation and Morita’s geometric explanation. During the development of the celiac artery and superior mesenteric artery, the splanchnic artery of rudiment arise from each segment of the primitive mesenteric artery. After the midgut
Fig. 3. Diagrams of the gastro-splenic trunks and hepato-mesenteric trunks in this case.

The gastro-splenic trunks branched from the abdominal aorta, as the first branch of the abdominal aorta. Left gastric artery and pancreatic branch had branched from the gastro-splenic artery. Below the gastro-splenic trunks, hepato-mesenteric trunks arises from the front wall of the abdominal aorta. The hepatic artery branched from this trunks, and ran ahead of the portal vein to the liver.

Fig. 4. Developmental pattern of the celiac trunk and the superior mesenteric artery for type I and type V of Adachi’s classification of the celiac trunk and the superior mesenteric artery (alteration from Morita).

Type V is a result of the disappearance of 3rd root that corresponds to common hepatic artery. Because of disappearance of 3rd root, it might be that the hepato-mesenteric trunk formed by superior mesenteric artery.
rotates, many anastomoses arise between the arteries. The artery of the left liver lobe rudiment and artery of the right liver lobe rudiment join to form the artery of the middle liver lobe rudiment, and form the common hepatic artery. These embryologic discussions make it possible to explain the variations in the celiac artery (Fig. 4).

In recent years the methods of diagnosis and treatment of the digestive diseases have become diversified and have improved. And that has led to a need for a grasp of the morphological characteristics of the blood vessels in a new aspect. Laparoscopic surgery is becoming increasingly popular with patients because the scars are smaller and the recovery period is shorter. However, because it is difficult to see the entire (surgical) operation area through the endoscope and the viscera cannot be directly touched.

Accordingly, there is risk of damaging blood vessels and the adjacent viscera as a result of inaccurate recognition. It is important to obtain information about the branching pattern of the blood vessels before the operation (Lee, 2003). Observation and analysis of the blood vessel distribution to the liver and adjacent organs is indispensable to diagnosis and local infusion of anticancer drugs (Tujimoto, 2004). Careful investigations of the vascular distribution and caution to prevent vascular injury are necessary during surgical operation on the head of pancreas when the branching pattern of the celiac artery is anomalous.

References


Key to Abbreviation

AA: abdominal aorta
CHA: common hepatic artery
CT: celiac trunk
DA: dorsal aorta
GST: gastro-splenic arterial trunk
GDA: gastroduodenal artery
HA: common hepatic artery
HMT: hepato-mesenteric trunk
HPA: hepatic proper artery
LAA: longitudinal anastomosis arteries
LGA: left gastric artery
PB: pancreatic branchi
PV: portal vein
PVSA1: the first root of primitive ventral splanchic artery
PVSA2: the second root of primitive ventral splanchic artery
PVSA3: the third root of primitive ventral splanchic artery
PVSA4: the fourth root of primitive ventral splanchic artery
SA: splenic artery
SMA: superior mesenteric artery