

# Multiple arteries supplying the human liver: A case report of a rare variation of the blood supplying pattern in a Japanese population

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## ABSTRACT

**Aims:** To report a rare variation of the blood vessels supplying the liver in Japanese. **Method:** With the gross dissection method, the main abdominal organs were removed in one bloc to observe the blood vessels supplying liver. **Results:** The vessels of the liver have four branches: the left hepatic artery, the right hepatic artery, a branch to the quadrate lobe, and a branch to the caudate lobe of the liver. **Conclusion:** This rare variation of the blood vessels supplying the liver is useful for clinical examination and surgical treatment.

**Keywords:** Blood supply variation, Celiac trunk, Hepatic artery, Human, Superior mesenteric artery

### How to cite this article

Yan J, Tokunaga K, Takahashi H, Hitomi J. Multiple arteries supplying the human liver: A case report of a rare variation of the blood supplying pattern in a Japanese population. *Edorium J Anat Embryo* 2015;2:1–5.

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Received: 06 January 2015

Accepted: 20 March 2015

Published: 16 April 2015

Article ID: 100002A04JY2015

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doi:10.5348/A04-2015-2-OA-1

## INTRODUCTION

It has been described in general anatomy textbooks that the blood vessels supplying the liver arise from the celiac trunk (common hepatic artery) [1–5]. However, variations of the artery supplying the liver have been reported [6–13]. Recently, the examination method and the endoscopic surgical treatment was also used for the liver and the gallbladder [14–17], therefore, the blood vessel variations of the liver became very important. This report aimed to document a rare vessel variation of the blood supply to the liver.

## MATERIAL AND METHODS

The cadavers (42 bodies) were dissected with normal gross anatomical method.

After opening the thoracic and abdominal cavity, the main abdominal organs (digestive tract from the esophagus to the descending colon, liver, pancreas, and spleen) were removed. First, the esophagus was cut at the collateral vagus nerve in the lower one-third; then, the inferior vena cava was cut at the low margin of the liver (cranial to the suprarenal vein). The descending colon was cut at the transition with the sigmoid colon. Finally, the celiac and superior mesenteric arteries which were generally present were cut at the origin(s) from the abdominal aorta. After removed the organs, the liver and the vessels supplying the liver were observed, photography and sketched.

This dissection method is useful to observe all of the vessels that are distributed throughout the main abdominal organs [18]. The cadavers were handled in

compliance with the ethical guidelines of Iwate Medical University.

## RESULTS

During a dissection course, a variation of the vessels supplying blood to the supramesocolic organs was observed in one cadaver (No. 24–47, woman; 95 years old; cause of death: pneumonia).

As shown in Figures 1 and 2, there are four branches that supply the liver: the left hepatic artery, the right hepatic artery, a branch supplying the caudate lobe, and a branch supplying the quadrate lobe.

1. The left hepatic artery: This artery originated from the left gastric artery which was a branch of the celiac trunk. The artery towards the left sulcus between the left lobe and caudate lobe entered and supplied the posterior part of the left lobe.
2. The branch supplying the quadrate lobe: In the present case, this branch was thicker than the left hepatic artery, and it seemed to take the general route of the left hepatic artery, although its origin was the gastroduodenal artery in this case. The artery passed along the left sulcus in the surface of the liver, then entered and became two branches distributed to the quadrate lobe and anterior part of the left lobe.
3. The branch supplying the caudate lobe: This branch was the thinnest of the four vessels. It originated from the gastroduodenal artery, which is an extension part of the celiac trunk, because the “common hepatic artery” did not exist in the present case. The branch entered from the center part of the surface of the caudate lobe.
4. The right hepatic artery: In the present case, this vessel was the thickest of the four vessels. The origin of this artery was the superior mesenteric artery. Along the right sulcus on the surface of the liver, three branches entered the right lobe to distribute blood to the anterior, medial, and posterior part of the right lobe. On the other hand, the artery also branched out to the cystic artery.

## DISCUSSION

The arteries supplying the liver were first described in nineteenth century ago [19, 20]. The typical classification pattern of the arteries supplying the liver has been reported by Michels [21–23]. According to artery origin, the distribution pattern of the hepatic arteries was classified into 10 types [22]. Subsequently, Hiatt et al. simplified the classification into five types [24]. In the present case, the number of hepatic arteries and their origins were not consistent with the previously described patterns. Recently, with advances in imaging technology,

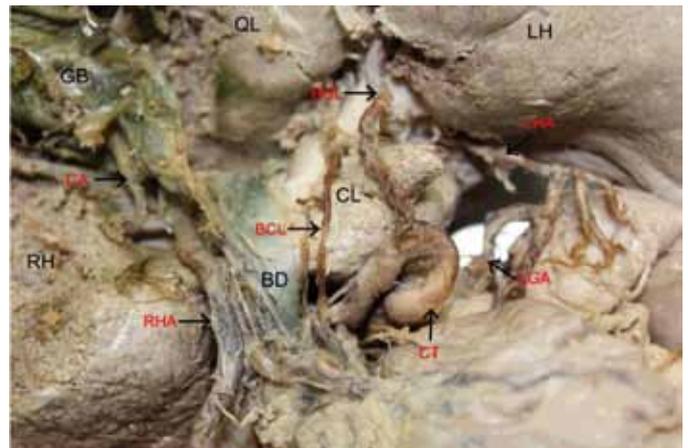


Figure 1: The photograph showing the arteries supplying the liver: the left hepatic artery (from left gastric artery), the right hepatic artery (from superior mesenteric artery), and the branches supplying the quadrate lobe and caudal lobe (from the extension part of the celiac trunk).

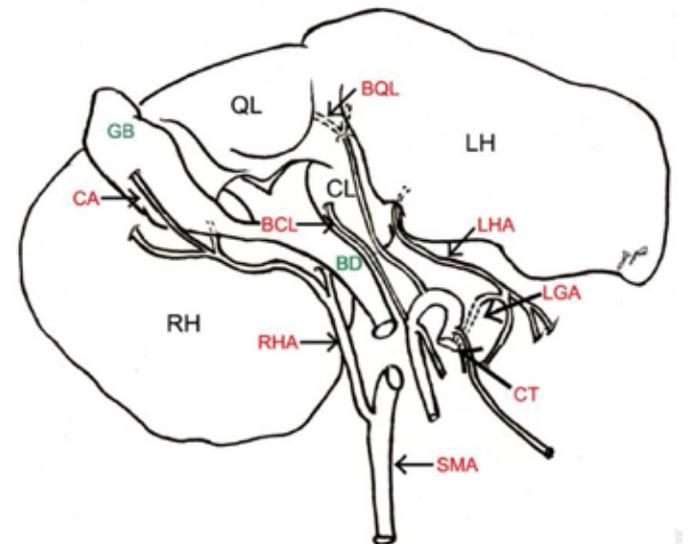


Figure 2: Sketch showing the variation pattern of the arteries. Note the branch to quadrate lobe and branch to caudal lobe were from the extension part of the celiac artery and supplied the lobes, respectively. The two branches could be considered as the “middle hepatic artery”.

the distribution pattern of hepatic arteries were further confirmed by magnetic resonance imaging and computed tomography imaging methods, and the pattern of the hepatic arteries has been classified into 14 to 16 types [14–16]; however, the pattern observed in the present case was not consistent with the previously reported classification. Therefore, the variation observed in the present case is considered very rare, and may be important for the surgical treatment and clinical examination of some patients with liver disease.

Three patterns of the arteries supplying the liver have also been reported, namely triple type (MSD type), double type (MS, MD, and SD type), and single type (M, S, and

D type) [9–11, 13, 25]; however, the branch supplying the quadrate and/or caudal lobe has not been discussed in detail. Generally, the branch supplying the caudal lobe was reported to originate from the left hepatic artery. Michels has indicated that the artery supplying the caudal lobe originated from the middle hepatic artery which commonly originates from the hepatic artery, although in 35% and 12% of cases, the artery originated from the right hepatic artery and left hepatic artery, respectively [22]. In the present case, the normal common hepatic artery was absent, and instead, one branch supplied the quadrate lobe and the other branch supplied the caudal lobe, each originating from the celiac artery. Therefore, we consider that the two arteries could together be considered as a middle hepatic artery. These variations were also different from those reported in literature. Moreover, “gastrohepatic trunk” has been proposed by Rusu et al. [26]. In this case the branches entered to quadrate lobe and caudal lobe (it seems as the middle hepatic artery) origin from celiac trunk respectively, but not from a common trunk with the right gastric artery, therefore we did not use the noun of “gastrohepatic trunk”.

## CONCLUSION

A rare variation (1/42 bodied) of the vessels supplying the liver was observed in a Japanese cadaver, In this case, the origins of the four artery branches were from the left gastric artery, gastroduodenal artery (two branches), and superior mesenteric artery, respectively. These observations may be useful for the surgical treatment and clinical examination of some patients with liver disease. Naturally, it is necessary to examine more cases of Japanese population.

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## Acknowledgements

We thank Mr. S. Takahashi and Mr. M. Hirakawa (Iwate Medical University) for their technical advice. This work was supported financially by the Advanced Medical Science Center of Iwate Medical University.

## Author Contributions

Jun Yan – Substantial contributions to conception and design, Acquisition of data, Analysis and interpretation of data, Drafting the article, Revising it critically for important intellectual content, Final approval of the version to be published

Karen Tokunaga – Analysis and interpretation of data, Revising it critically for important intellectual content, Final approval of the version to be published

Hirota Takahashi – Analysis and interpretation of data, Revising it critically for important intellectual content, Final approval of the version to be published

Jiro Hitomi – Analysis and interpretation of data, Revising it critically for important intellectual content, Final approval of the version to be published

## Guarantor

The corresponding author is the guarantor of submission.

## Conflict of Interest

Authors declare no conflict of interest.

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## ABBREVIATION

BCL: branch to caudal lobe; BD: bile duct; BGL: branch to quadrate lobe; BQL: branch to quadrate lobe; CA: cystic artery; CT: celiac trunk; CL: caudal lobe; GB: gall bladder; LGA: left gastric artery; LH: left lobe; LHA: left hepatic artery; QL: quadrate lobe; RH: right lobe; RHA: right hepatic artery.

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**Article citation:** Yan J, Tokunaga K, Takahashi H, Hitomi J. Multiple arteries supplying the human liver: A case report of a rare variation of the blood supplying pattern in a Japanese population. *Edorium J Anat Embryo* 2015;2:1–5.



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