ORIGINAL ARTICLE

http://dx.doi.org/10.3126/njr.v12i2.54596

Anatomy and Variants of Hepatic Arteries in 120 Patients Studied with 128 Slice Volumetric Scan in Nepalese Population

Paudel B, Adhikari D, Raut YR, Paudyal S

Chitwan Medical College, Bharatpur, Nepal

Received: September 19, 2022 **Accepted:** November 15, 2022 **Published:** December 31, 2022

Cite this paper:
Paudel B, Adhikari D, Raut YR, Paudyal S. Anatomy and Variants of Hepatic Arteries in 120 Patients Studied with 128 Slice Volumetric Scan in Nepalese Population. *Nepalese Journal of Radiology* 2022;12(2):27-32. http://dx.doi.org/10.3126/njr.v12i2.54596

ABSTRACT

Introduction:

Modern advances in radiology, imaging, and novel surgical methods have greatly aided doctors in making both surgical and non-surgical decisions. During surgery, anatomical variances are frequently encountered by surgeons, making operation complex and occasionally challenging. The purpose of our study was to evaluate the hepatic artery and its variants, including the length and diameter of the right and left hepatic arteries. This information is vital for patients undergoing major hepatic surgeries and hepatic transplantation

Methods:

A total of 120 patients who underwent contrast-enhanced Triphasic CT of the abdomen were evaluated with the consent of the ethics committee at Chitwan medical college. Study subjects were selected on a random basis, who had no previous abdominal or hepatic surgeries, and without the known hepatic disease.

Results:

Out of 120 participants, 63 (52.5%) were male and the rest 57(47.5 %) were females. Normal anatomy was observed in 104 cases (86.7%) and the rest of the 16 cases showed an anomalous hepatic arterial pattern, which consisted of Michel's type III in 6 cases (5%), Type IV in 1 case (0.8%) and Type X in 3 cases (2.5%); and 5 cases (4.2%). did not fall under Michel's Classification. Supply to segment IV of the liver was observed from Left hepatic artery in 97 cases (80.8%) and from the right hepatic artery in 23 cases (19.2%).

Conclusions:

Many hepatic arterial variants which did not fall under Michel's classification were observed in our population

Keywords: *Hepatic Artery Diameter; Hepatic Artery Length; Hepatic Artery Variants*

Correspondence to: Dr. Bigyan Paudel
Department of Radiology
Chitwan Medical college
Bharatpur, Chitwan, Nepal
Email: *bigyan11111@gmail.com*

INTRODUCTION

In present times, developments in Radiology and imaging and newer surgical techniques have tremendously helped clinicians in making surgical as well as non-surgical decisions. During surgery, many times anatomical variations are encountered by surgeons, which make surgery challenging and sometimes difficult.[1] Even in the liver, the detailed anatomy of hepatic arterial anatomy is a must, for interventional radiology attempting a transcatheter embolization, for a surgeon who is attempting liver resection, and for a transplant surgeon who is trying anastomosis of the hepatic arteries.[2] Right and left hepatic arteries are branches of the proper hepatic artery, which is a branch of the common hepatic artery, after it gives the gastroduodenal artery. The common hepatic artery is one of the three branches of the celiac trunk. This is the normal, commonly encountered arterial configuration of the liver. A newer development is 128-slice CT helps in the evaluation of the whole body in just one breath hold, and provides high-resolution images of the body, minimizing artefacts. 3D images can be constructed from modern CT and are quite helpful for clinicians to understand anatomy. The information obtained from multiplanar images as well as 3D images will help understand the anatomy of the arterial supply of the liver.[3] In a study done by De Cecco et al. normal hepatic arterial pattern was observed in 66% of cases while 34% of cases show an anomalous hepatic arterial pattern.[4] Surgically, it is important to measure the length of the right hepatic artery(RHA) and left hepatic artery(LHA) from their origin till the next bifurcation. When the length of the artery is more than 1 cm and the diameter of the artery is more than 2 mm it is preferable for anastomotic purposes. Dominant arterial supply to segment IV of the liver is very important because it helps in the regeneration of the donor's liver.[5] Our study aims to examine the normal anatomic pattern and anatomic variation of the hepatic arterial system using a 128-slice volumetric CT scan.

METHODS

Patient population:

A total of 120 patients who underwent contrast-enhanced Triphasic CT of the abdomen were evaluated with the consent of the ethics committee at Chitwan medical college. These patients presented with a variety of pathological conditions. Patients with extensive liver disease and a history of previous surgery were excluded from the study.

Imaging technique:

MDCT was performed using 128 slice volumetric CT system. Acquisition parameter includes: Tube voltage:120kVp, Detector collimation:128x0.3 mm and pitch:1. Nonionic contrast media was injected at a dose of 1.5 ml/kg for the performance of the contrast Triphasic abdominal CT scan. The contrast media was injected by an automatic double-head power injector at 5ml/second through an IV plastic cannula. Bolus tracking was done with ROI(Region of interest) being placed at the abdominal aorta just caudal to the dome of the diaphragm, with a trigger threshold value set at 100 HU with 4 seconds of delay.

To define the arterial pattern, analysis was carried out in the axial plane, reconstruction techniques in the coronal and sagittal planes on multiplanar reconstruction (MPR) as well as three dimensional (3D) reconstructions with maximum intensity projection (MIP) and volume rendering technique (VRT). The normal pattern and main variations of the hepatic arterial system were demonstrated. Anatomical variations are grouped according to Michel's classification. Arterial variants not included in Michel's classification were recorded separately. The frequency of various anomalies was calculated. Michel's classification of hepatic artery variation, which is commonly used in practice, is given below:

Table 1: Michel's classification of hepatic artery variations.[6]

Type	Description
I	Hepatic Trunk arising from Common Hepatic Artery (CHA)
II	Replaced Left Hepatic Artery arising from Left Gastric Artery (LGA)
III	Replaced Right Hepatic Artery arising from Superior Mesenteric Artery (SMA)

IV	Replaced Left hepatic Artery and Replaced Right Hepatic Artery
V	Accessory Left Hepatic Artery arising from Left Gastric Artery (LGA)
VI	Accessory Right Hepatic Artery arising from Superior Mesenteric Artery (SMA)
VII	Accessory Left Hepatic Artery and Right Hepatic artery
VIII	Replaced Right Hepatic Artery and Accessory Left Hepatic Artery
IX	Replaced Left Hepatic artery and Accessory Right Hepatic artery
X	Entire Hepatic trunk arising from Superior Mesenteric artery (SMA)

RESULTS:

All 120 data were considered technically adequate and none of the patient data was excluded by subsequent analysis. We studied 63 males (52.5%) and 57 females (47.5 %) with a mean age of 49.6 (SD:18.6). As illustrated in the tables below (Tables 2, 3 and 4).

Normal anatomy was observed in 104 cases (86.7%), while rest 16 cases showed an anomalous hepatic arterial pattern. The anomalies consisted of Michels Type III in 6 cases (5%) cases, Type IV in 1 case (0.8%) cases and type X in 3 (2.5%) cases. We also found 5 cases which did not fall under Michel's classification, and consisted of the following-

1. Accessory Left hepatic artery arising from the celiac trunk.
2. Left hepatic artery arising from the celiac trunk and the right hepatic artery arising directly from the aorta.
3. The right hepatic artery arising as a direct branch of the celiac trunk, and the left hepatic artery arising from the common hepatic artery.
4. Left hepatic artery from the celiac trunk, and right hepatic artery from the common hepatic artery.
5. Right and left hepatic arteries arising separately from the superior mesenteric artery.

We didn't find any cases of Michel's type II, V, VI, VII, VIII and IX.
Various findings are shown in Figures 1, 2, 3 and 4.

Table 2: Total sex distribution of the patient population in the study.

Sex	Frequency	Percent
Male	63	52.5
Female	57	47.5
Total	120	100

Table 3: Total distribution of Hepatic artery and its variants

Hepatic arterial anatomy	Frequency	Percent
Hepatic trunk arising from CHA	104	86.7
Replaced RHA arising from SMA	6	5
Replaced LHA and replaced RHA	1	0.8
Accessory RHA arising from SMA	1	0.8
Entire hepatic trunk arising from SMA	3	2.5
Others	5	4.2
Total	120	100

Table 4: Table showing dominant supply to segment IV of liver

Dominant supply to segment IV	Frequency	Percent
RHA	23	19.2
LHA	97	80.8
Total	120	100

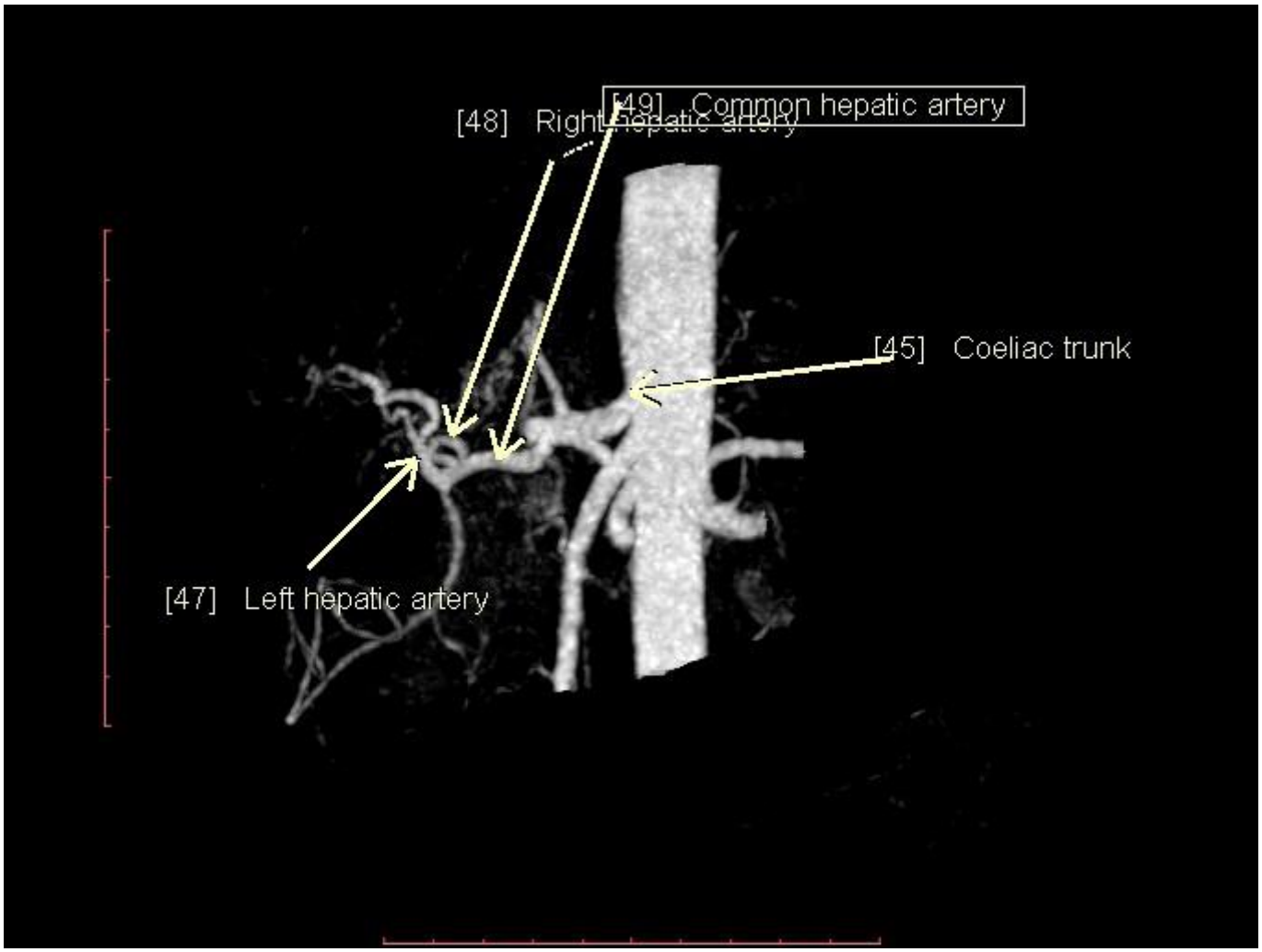

Figure 1: *Normal pattern of the hepatic arterial system*

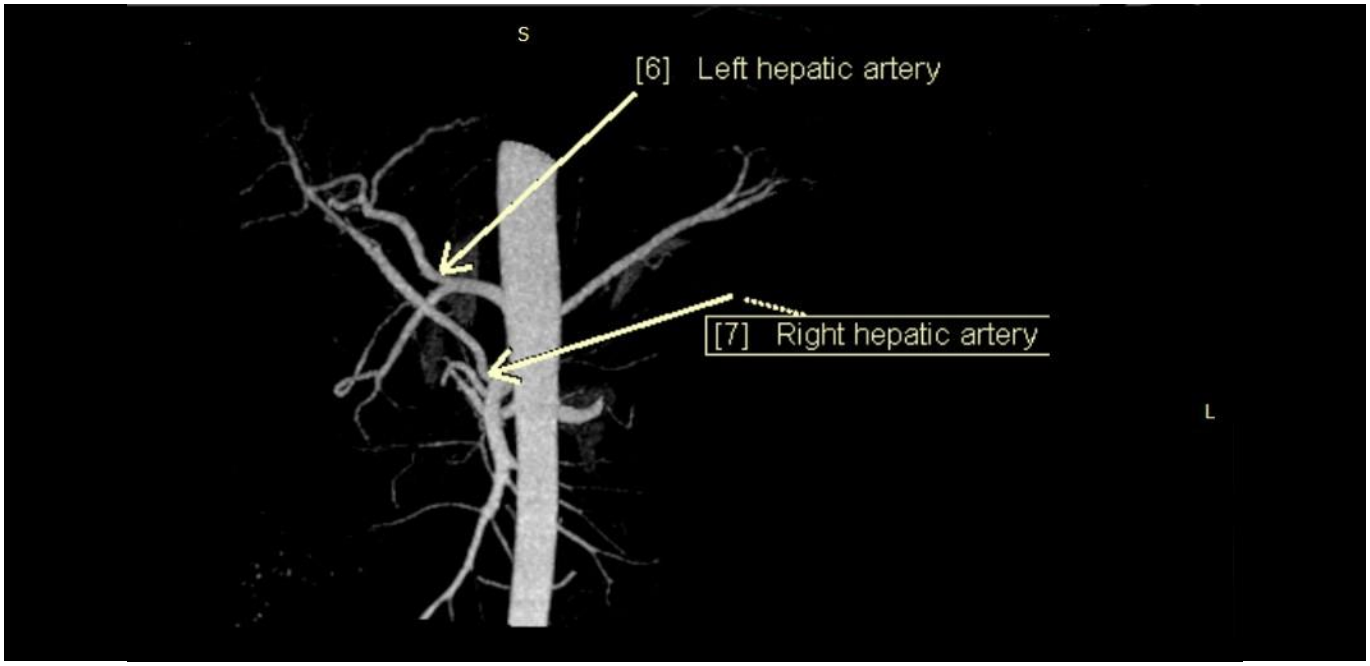

Figure 2: *Replaced right hepatic artery arising from the superior mesenteric artery*

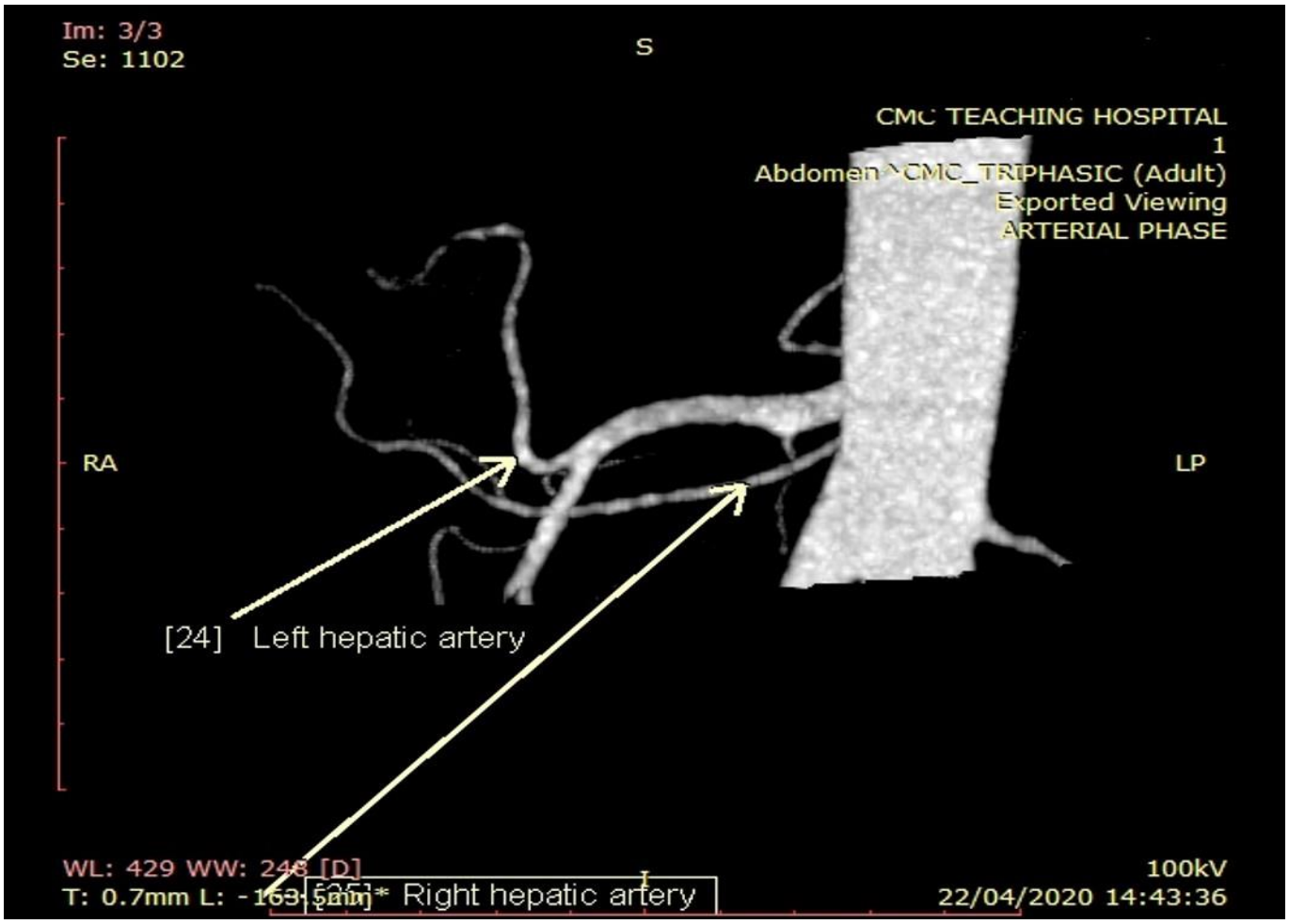

Figure 3: *Right hepatic artery arising from the aorta*

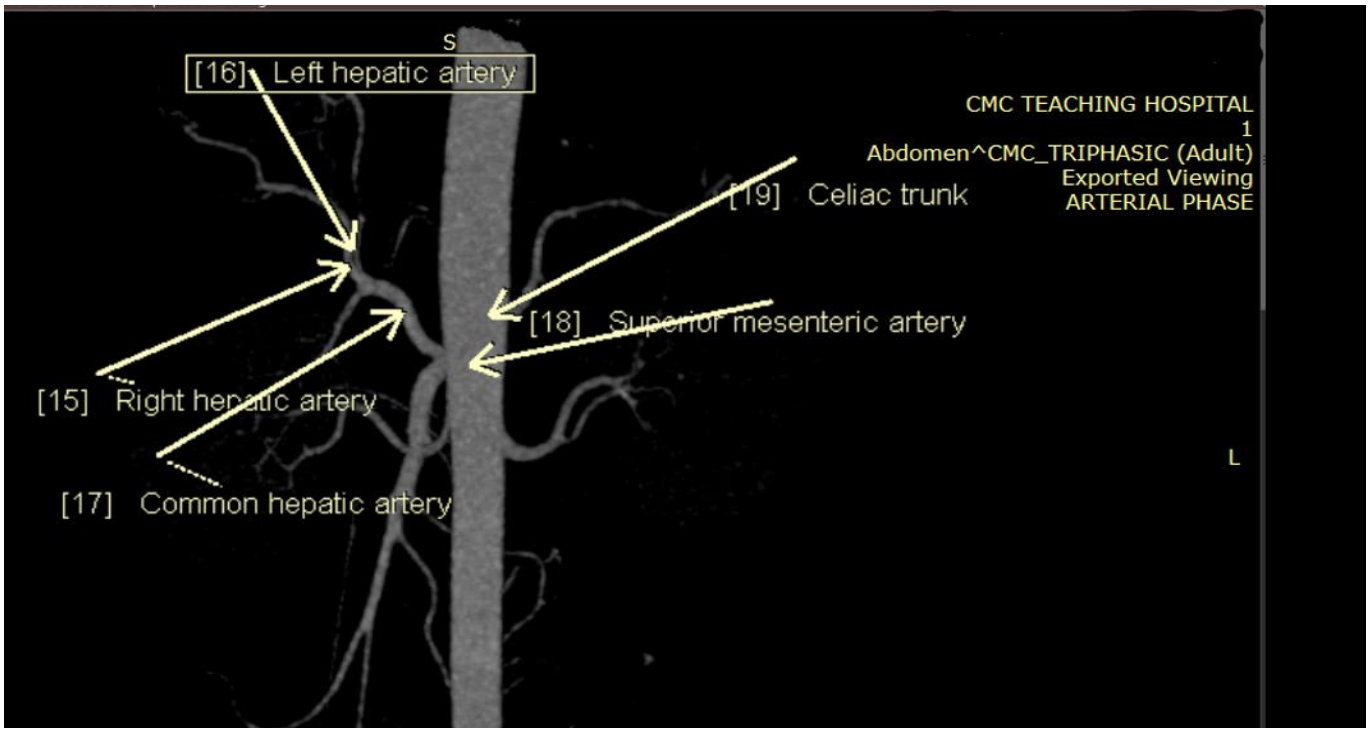

Figure 4: *Common hepatic trunk arising from Superior mesenteric artery*

DISCUSSION

At the time of writing, this article is the sole article describing hepatic arterial anatomy in the Nepalese population. Our study has concordance with other studies in that Michels Type I pattern of Hepatic artery is present in most frequency in most of the population group, which in our case is approximately 86.7% cases. Type III (replaced RHA) is the most common variant (3.7%) according to Michels.[6] Our study also found that Type III is the most common variant comprising 5% of the cases.

Besides this, our study shows the presence of different patterns of hepatic arterial pattern in our population compared to rest of the world. Approximately 4.2% cases had hepatic arterial patterns not included in Michel's classification.

In a study done by De Cecco et al., the normal hepatic arterial pattern was observed in 66% of cases while 34% of cases show anomalous hepatic arterial patterns.[3] A similar observation was noted in our study.

The preoperative knowledge of these anomalies have high clinical significance especially in people undergoing hepatic resection and hepatic transplants. Nepal has recently started Liver transplantation, with a few successful Liver transplantation performed within the country to date of writing of the article, and knowledge of anatomy of hepatic artery in our population is utmost to help in surgery and to minimise surgical mortality and morbidity. Furthermore, knowledge of hepatic arterial anatomy may also be useful in Transcatheter arterial chemoembolisation, which has been started in many centres in Nepal.

CONCLUSION

With the advent of CT scans in modern Radiology, we can visualise the hepatic vascular anatomy in quite detail by non-invasive methods. Many variants in hepatic arterial anatomy are seen in the Nepalese population in our study which was not given by Michel's classification. With the recent increase in interventional radiology procedures and the possiblity of regular hepatic transplantations, the findings in our study might be of high value for intervention radiologists and hepatic surgeons.

CONFLICT OF INTEREST

None

SOURCES OF FUNDING

None

REFERENCES

1. Araujo Neto SA, Franca HA, Mello Júnior CF et al. Anatomical variations of the celiac trunk and hepatic arterial system: an analysis using multidetector computed tomography angiography. *Radio Bras* 2015;48(6):358-62. https://doi.org/10.1590%2F0100-3984.2014.0100
2. Winter 3rd TC, Nghiem HV, Freeny PC, Hommeyer SC, Mack LA. Hepatic arterial anatomy: demonstration of normal supply and vascular variants with three-dimensional CT angiography. *Radiographics* 1995;15(4):771-80. https://doi.org/10.1148/radiographics.15.4.7569128
3. Ugurel MS, Battal B, Bozlar U et al. Anatomical variations of hepatic arterial system, coeliac trunk and renal arteries: an analysis with multidetector CT angiography. *Br J Radiol* 2010;83(992):661-7. https://doi.org/10.1259%2Fbjr%2F21236482
4. De Cecco CN, Ferrari R, Rengo M, Paolantonio P, Vecchietti F, Laghi A. Anatomic variations of the hepatic arteries in 250 patients studied with 64-row CT angiography. *Eur Radiol* 2009;19(11):2765-70. https://doi.org/10.1007/s00330-009-1458-7
5. Vohra S, Goyal N, Gupta S. Preoperative CT evaluation of potential donors in living donor liver transplantation. *Indian J Radiol Imaging* 2014;24(04):350-9. https://doi.org/10.4103/0971-3026.143897
6. Michels NA. Newer anatomy of the liver and its variant blood supply and collateral circulation. *Am J Surg* 1966;112(3):337-47. https://doi.org/10.1016/0002-9610(66)90201-7