ORIGINAL ARTICLE

HEPATIC ARTERIAL VARIATIONS AND ITS IMPLICATIONS ON HEPATOBILIARY SURGERY

Awais Ahmed, Rashed Nazir, Rayyan Pervez, Umar Amin, Atif Rana, Muhammad Yousaf Chaudary

Department of Radiology, Shifa International hospital, Islamabad, Pakistan.

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ABSTRACT

AIM: To assess the hepatic arterial variations on Multidetector CT (MDCT) and its clinical significance in hepatobiliary procedures. **MATERIALS AND METHODS:** This was a retrospective study in which 1000 post-contrast CT scans of the abdomen were reviewed at the Department of Radiology between July 2011 and June 2012. All CT's in which arterial phase imaging was performed were included. Postsurgical cases and cases of vascular thrombosis and arteriovenous malformation were excluded from the study. **RESULTS:** Out of the 10 Mitchel's hepatic arterial variations, 9 were seen in the study cohort. Type I was the most common as 678 (67%) patients had it. Type II variation was seen in 178 (17%) patients, type III in 34 (3.4%) type V in 25 (2.5%) patients. Apart from this, we found 17 types of rare variations in which the most common were common hepatic artery arising directly from aorta (0.7%), right hepatic artery arising from aorta and left hepatic artery arising from left gastric artery (0.6%) and both right and left hepatic arteries arising from celiac axis (0.4%). **CONCLUSION:** This is one of the largest studies in Asia on this topic. Majority of Pakistani population has conventional hepatic arterial anatomy but the types of variations noted are more diverse. Of note a greater percentage had type II anatomy which increases complexity of hepatic transplant surgery.

Keywords: Hepatic arterial variations, Mitchel's classification, Hepatobiliary surgery.

Introduction

In upper abdominal surgery, hepatic arterial blood flow should be preserved whenever possible to avoid or minimize serious hepatic ischemic complications. One can best achieve this by recognizing potentially challenging areas of the hepatic arterial anatomy and three-dimensional (3D) detailed evaluation in relation to the adjacent organ at preoperative imaging.[1] Even in interventional radiology, prepro-cedural CT evaluation of the celiac axis and hepatic arterial anatomy can help one perform and interpret the findings of diagnostic angiography for intra-arterial management of hepatic tumors and perform embolotherapy for haemorrhage.[2,3] Therefore, diagnostic as well as interventional radiologists should be familiar with the spectrum and cross-sectional and 3D appearances of variations in the celiac axis and hepatic artery anatomy.

Correspondence : Dr. Awais Ahmed
Department of Radiology,
Shifa International Hospital,
Islamabad, Pakistan.
Email: dr.ahmed555@gmail.com

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Material and Methods

After approval from Institutional Review Board and Ethics committee, a retrospective study was done in which 1000 post-contrast CT scans of the abdomen were reviewed that had been performed on TOSHIBA 320 slice CT between July 2011 and June 2012. CT scans with arterial phase image acquisition were included.Postsurgical cases and cases of vascular thrombosis and arterio venous malformation were excluded from the study.
The origin of hepatic arteries was categorized according to Mitchel's classification (Tab. 1).

Types	Description
I	Entire hepatic trunk arising from CHA
II	Replaced LHA from LGA
III	Replaced RHA from SMA
IV	Replaced LHA and replaced RHA
V	Accessory LHA from LGA
VI	Accessory RHA from SMA.
VII	Accessory RHA and accessory LHA
VIII	Replaced LHA and accessory RHA or replaced RHA and accessory LHA
IX	Entire hepatic trunk arising from SMA
X	Entire hepatic trunk arising from LGA

Table 1 : Mitchel's Classification of Hepatic Arterial Variations

Results

Out of the 10 Mitchel's hepatic arterial variations, 9 were observed in study cohort (Fig.1 and 2). Type I was most common as 678 (67%) patients had it (Fig. 3). Type II variation (Fig. 4) was seen in 178 (17%) patients, type III (Fig. 5) in 34 (3.4%) type V (Fig. 6) in 25 (2.5%) patients.

Apart from this, we also found 17 types of rare variations in which the most common were common hepatic artery (CHA) arising directly from aorta (0.7%) (Fig. 7), right hepatic artery (RHA) arising from aorta and left hepatic artery (LHA) arising from left gastric artery (0.6%) (Fig. 8) and both right and left hepatic arteries arising from celiac axis (0.4%).

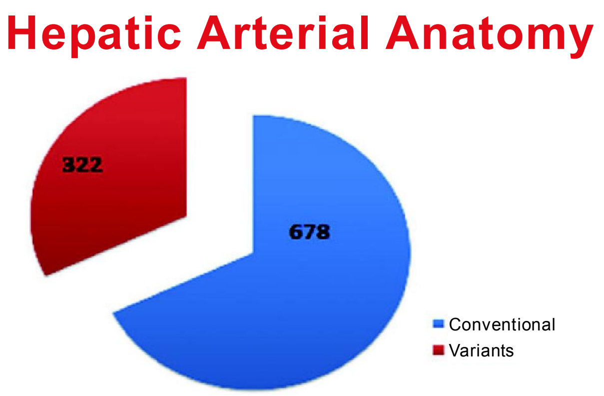

Figure 1: Pie chart showing the comparison of result of classical type 1 anatomy and other variations

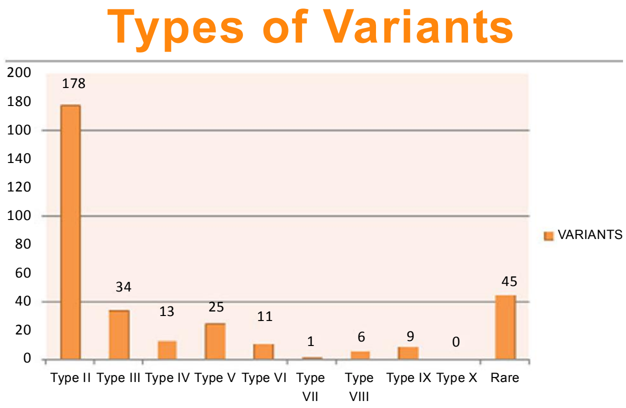

Figure 2: Bar chart showing the result of different types of hepatic arterial variations

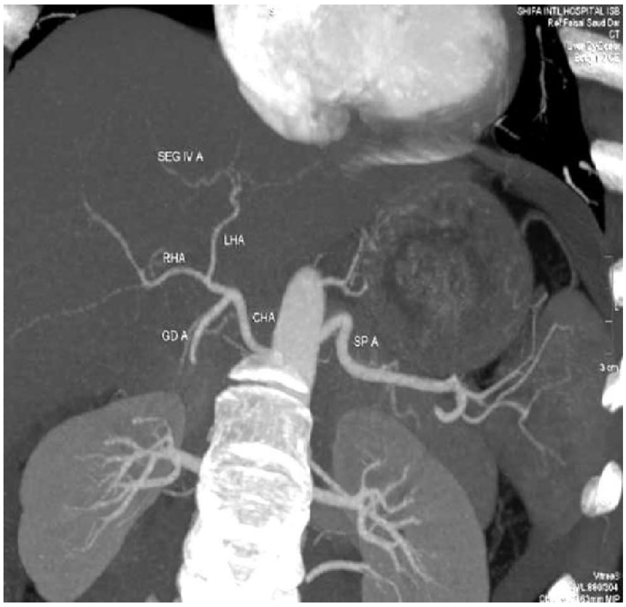

Figure 3: Coronal MIP image showing classical type I hepatic arterial anatomy.

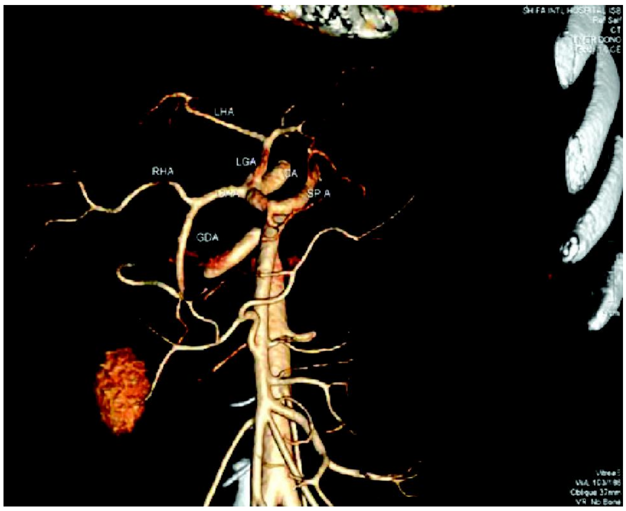

Figure 4: Oblique MIP image showing replaced left hepatic artery from left gastric artery (type II)

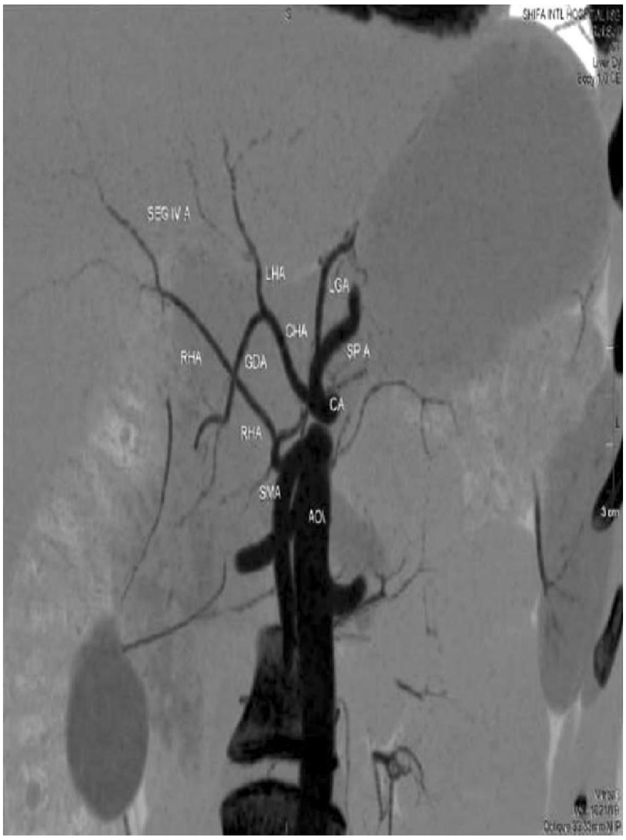

Figure 5: Coronal MIP image showing replaced RHA from SMA (type III).

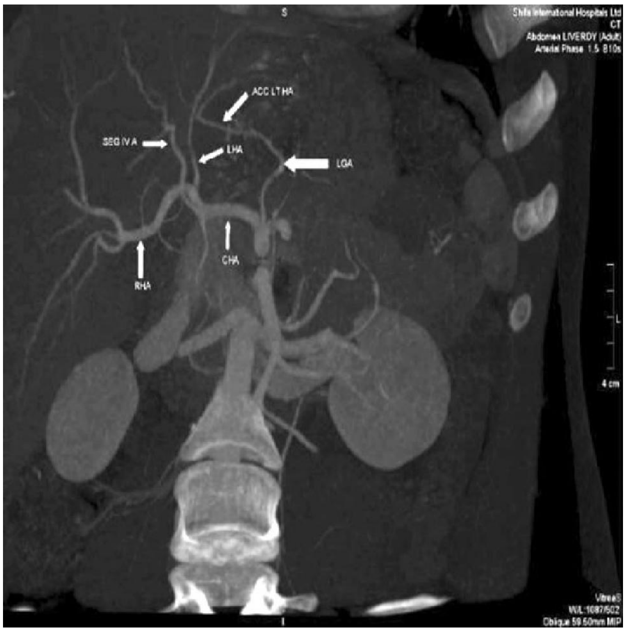

Figure 6: Oblique MIP image showing Accessory LHA from LGA (type V).

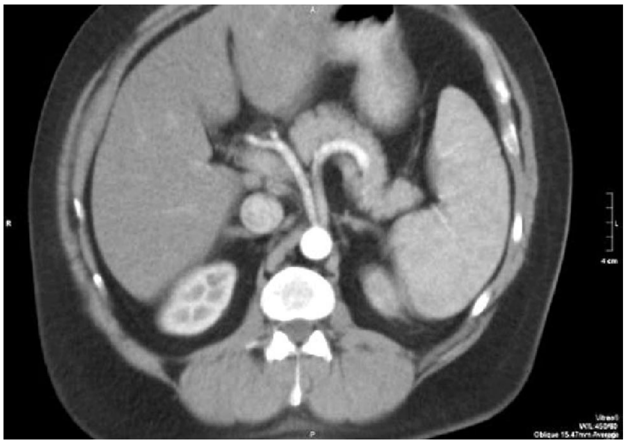

Figure 7: Axial MIP image showing CHA arising directly from Aorta

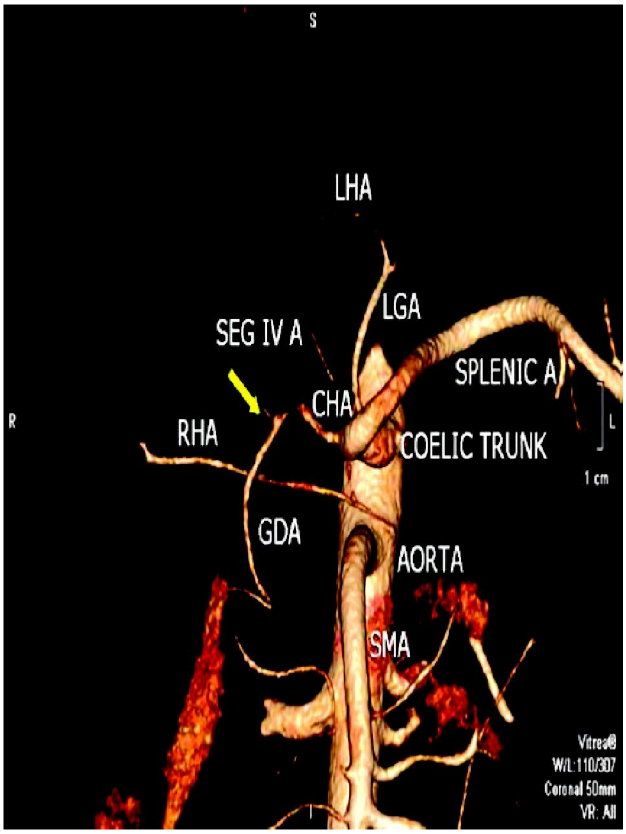

Figure 8: Oblique MIP image showing RHA arising directly from Aorta and replaced LHA from LGA

Other variants were:

- Main RHA arising directly from Aorta, CHA dividing into LHA and accessory RHA.
- Main RHA from CHA, Accessory RHA from Aorta.
- Main RHA directly from celiac axis, Accessory RHA from CHA.
- Main RHA arising from Superior mesenteric artery

(SMA), CHA dividing into LHA and accessory RHA.
- Replaced both RHA (from SMA) and LHA (from left gastric artery) with accessory RHA from CHA.
- Accessory RHA from celiac axis.
- Accessory LHA from CHA.
- RHA arising directly from Aorta, LHA from CHA.
- RHA arising directly from celiac axis, LHA from CHA.
- RHA arising directly from celiac axis, LHA replaced from left gastric artery (LGA).
- RHA replaced from SMA, LHA arising from celiac axis.
- Main RHA and LHA arising directly from celiac axis with accessory LHA from LGA.
- Main and accessory RHA from celiac axis, LHA replaced from LGA.
- Main RHA and accessory LHA from celiac axis, main LHA from CHA.

Discussion

Living related liver transplantation (LRLT) is an excellent treatment method for patients with end-stage liver disease. Assessment of the hepatic arterial anatomy is one of the most important steps in the preoperative evaluation of potential liver donors because hepatic arterial anatomy is extremely variable and some anatomic variations may necessitate modification of the surgical approach.[4-6]
A replacedor accessory left hepatic artery from the left gastric artery is not important in a donor, whose left lobe is going to be left in place, but it is relevant in a recipient because, during native liver removal, extra steps are required to ligate it at the origin.[7]
Identification of a replaced right hepatic artery is critical when performing pancreaticoduodenectomy and for porta hepatis dissection during hepatic resection. Whereas the right hepatic artery usually courses anterior to the right portal vein, the replaced right hepatic artery originates from the SMA, courses posterior to the main portal vein in the portacaval space, and classically ascends posterolateral to the common bile duct.[8] Palpation for the presence of the artery can be unreliable when there is portal inflammation, enlarged portal lymph nodes, or an existingbiliary stent. In a patient with cancer in the pancreatic head or uncinate process, a replaced right hepatic artery may be involved by tumor, precluding the patient from surgical resection. If the right hepatic artery is not involved, particular care needs to betaken in this region so as not to inadvertently injure such an artery during dissection. This is especially important because patients with pancreatic head tumors are often jaundiced. Unlike the non jaundiced patient, in whom the portal blood flow can sustain viability of the liver, the liver in the jaundiced patient is prone to hepatic necrosis if the arterial blood flow is compromised.[9] Therefore, the surgeon may choose biliary drainage for the jaundiced patient with replaced right hepatic artery to relieve the jaundice before pancreatico duodenectomy.
In recent years, clinical data have shown hepatic artery infusional chemotherapy to have efficacy as adjuvant to resection in controlling hepatic disease.[10] The goal of intra-arterial chemotherapy is to provide uniform perfusion of the chemotherapeutic agent throughout the liver. The catheter is surgically placed via an arteriotomy in the gastroduodenal artery with the catheter tip inserted up to-but not beyond-the junction of the gastroduodenal artery and the common hepatic artery. Variant arterial anatomy does not necessarily preclude a patient from placement of a pump. Recognition of a replaced or an accessory artery is important so that the vessel can be ligated at the time of catheter placement to allow uniform perfusion of the hepatic parenchyma.[11] The limitation of this study include that the variations were not confirmed on conventional angiography.

Conclusion

This is one of the largest studies in Asia on this topic. Majority of Pakistani population has conventional hepatic arterial anatomy but the types of variations noted are more diverse. Of note a greater percentage had type II anatomy which increases complexity of hepatic transplant surgery.

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