STUDY OF ANATOMIC VARIANTS OF HEPATIC ARTERIES IN CONTRAST ENHANCED COMPUTED TOMOGRAPHY SCAN OF ABDOMEN

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ABSTRACT

Aim: The objective of the present study was to assess the anatomic variants of hepatic artery in contrast enhanced computed tomography scan of abdomen.

Methods: The Prospective Study was conducted at tertiary care Hospital where 300 patients were included in the study. Institutional Ethical Committee (IEC) clearance was obtained before the start of the study. Informed consent and written consent were obtained from all the parents/guardians.

Results: Maximum number of study individuals were belonged to 51-60 years age group (29%), followed by 20-30 years age group (25.7%). There were 143 females and 157 males in the study population. Among the study population, 267 (89.00%) individuals had complete course of right

hepatic artery (i.e.no accessory hepatic artery and no aberrant hepatic artery). 24 (8%) individuals had aberrant right hepatic artery while 9 (3%) individuals had accessory right hepatic artery. Among the study population, 260 (86.00%) individuals had complete course of left hepatic artery (i.e.no accessory hepatic artery and no aberrant hepatic artery). 27 (9.7%) individuals had aberrant left hepatic artery while 13 (4.3%) individuals had accessory left hepatic artery.

Conclusion: Knowledge of variant anatomy is important prior to surgical and interventional procedures which can reduce the incidence of post-operative complications.

Keywords: Anatomical variant; Hepatic artery; Aberrant hepatic artery, Accessory hepatic artery, Computed tomography

INTRODUCTION

Recent developments in surgical techniques, in organ transplants and in imaging methods help physicians to make decisions regarding the most appropriate choice of the several therapeutic possibilities, either surgical or non-surgical. However, many times, physicians face anatomical variations that can impair diagnosis or the performance of surgical procedures. Thus, it is important to have appropriate knowledge on the human anatomy and its most frequent variations that affect a population.[1-3] The hepatic arterial system (HAS) described as normal is characterized as a right and left hepatic artery coming from the hepatic artery proper, which, by its turn, originates from the common hepatic artery, after emergence of the gastroduodenal artery, which runs inferiorly. The division of the hepatic artery proper into right and left hepatic arteries should occur proximally to the liver within the hepatoduodenal ligament.

It is regarded as typical or normal if the right, left, and middle hepatic arteries, which branch out of the celiac trunk and supply the right, left, and quadrate lobes of the liver, respectively, are able to do so. A liver artery that does not originate from the conventional celiacal hepatic artery is referred to as "aberrant" and can either be auxiliary or replaced. Anomalous hepatic arteries come in two different varieties. Only circumstances when the normal right or left hepatic artery (arising from celiac artery) is present in addition to an extra artery coming from another source should be referred to as having "accessory" hepatic artery. In other words, under no other circumstances could the phrase "accessory" hepatics be employed. When the normal right or left

hepatic artery (arising from celiac artery) is absent, a blood vessel called a "replaced" right or left hepatic artery develops from another source to serve the right or left lobe. This expression is used because the vessel can supply either the right or left lobe.[4]

According to Ugurel et al[5], in a retrospective study of 100 computed tomography (CT) images, HAS with variations was found in 48% of the cases. Sebben et al., in a study of 30 cases, have reported variation in 40% of their cases[6], while the Sobotta Anatomy Atlas records variation of this artery in 35% of the cases.[7] Iezzi et al[8], on its turn, has found a variation of 27.9% in a sample of 524 cases.

The objective of the present study was to assess the anatomic variants of hepatic artery in contrast enhanced computed tomography scan of abdomen.

MATERIALS AND METHODS

The Prospective Study was conducted at tertiary care Hospital in India from September 2020 to August 2022 and 300 patients were included in the study. Institutional Ethical Committee (IEC) clearance was obtained before the start of the study. Informed consent and written consent was obtained from all the parents/guardians.

Method of diagnosis: Philips 128 slice CT scan

INCLUSION CRITERIA

•Adults (males and females) undergoing triple phase contrast CT of abdomen

EXCLUSION CRITERIA

•Pediatric patients

•Patients who underwent upper abdominal surgery which may potentially disturb arterial anatomy.

•Abdominal pathologies hindering visualization of abdominal arteries

•All patients contraindicated for CT scan

•All patients contraindicated for Contrast injection

In order to define the arterial pattern, analyses were carried out in the axial plane, reconstruction techniques in the coronal and sagittal planes on multiplanar reconstructions (MPR), as well as three-dimensional (3D) reconstructions with the maximum intensity projection (MIP) and volume rendering (VTR) techniques. The normal pattern and the main variations of HAS were demonstrated.

Patients presenting with aneurysm or abdominal aortic prosthesis, history of liver or gastric surgery and/or poor image quality including those caused by failure in intravenous contrast uptake in the studied vessels, were not included in the analysis. For the analysis of the obtained data, a statistical method was selected, based on the adherence to the model of normal distribution and equality of variance.

RESULTS

Table 1: Demographic details

Age group	**No of cases**	**Percentage**
20-30	77	25.7%
31-40	66	22%
41-50	70	23.33%
51-60	87	29%
Gender		
Female	143	47.67%
Male	157	52.33%

Maximum number of study individuals were belonged to 51-60 years age group (29%) followed by 20-30 years age group (25.7%). There were 143 females and 157 males in the study population, for a gender split of 47.67% and 52.33% respectively.

Table 2: Analysis of hepatic arteries and source of accessory right and left hepatic arteries in the study population

Type	No of cases	Percentage
Right hepatic artery		
Aberrant	24	8%
Accessory	9	3%
Complete	267	89%
Left hepatic artery		
Aberrant	27	9.7%
Accessory	13	4.3%
Complete	260	86%

Among the study population, 267 (89.00%) individuals had complete course of right hepatic artery (i.e. no accessory hepatic artery and no aberrant hepatic artery). 24 (8%) individuals had aberrant right hepatic artery while 9 (3%) individuals had accessory right hepatic artery.

Among the study population, 260 (86.00%) individuals had complete course of left hepatic artery (i.e. no accessory hepatic artery and no aberrant hepatic artery). 27 (9.7%) individuals had aberrant left hepatic artery while 13 (4.3%) individuals had accessory left hepatic artery.

Table 3: Analysis of source of aberrant right and left hepatic arteries in the study population

Accessory origin	Frequency	Percentages
Right hepatic artery	**9**	**3%**
Superior mesenteric artery	6	2%
Celiac artery	3	1%
Left hepatic artery	**10**	**3.33%**
Left gastric artery	10	3.33%

9 (3%) individuals had accessory right hepatic artery with 6 (2%) individuals had its origin from superior mesenteric artery and 3 (1%) individuals had its origin directly from celiac artery.
10 (3.33%) individuals had accessory left hepatic artery with all of them originating from left gastric artery.

Table 4: Analysis of source of aberrant right and left hepatic arteries in the study population

Aberrant origin	**Frequency**	**Percentages**
Right hepatic artery	**24**	**8%**
Superior mesenteric artery	9	3%
Gastroduodenal	6	2%
Celiac axis	4	1.33%
Aorta	3	1%
Splenic artery	1	0.33%
Left gastric artery	1	0.33%
Left hepatic artery	**27**	**9%**
Left gastric artery	12	4%
Celiac artery	7	2.33%
Aorta	5	1.66%
Superior mesenteric artery	3	1%

In the study population, 24(8%) individuals had aberrant origin of right hepatic artery. Superior mesenteric artery (9 individuals – 3%) was the commonest source of origin of aberrant right hepatic artery followed by gastroduodenal artery (6 individuals – 2%), celiac artery (4 individuals – 1.33%) and aorta (3 individuals – 1%). 2 (0.66%) individuals had other source of origin of right hepatic artery (one each from splenic artery and left gastric artery). In the study population, 27(9%) individuals had aberrant origin of left hepatic artery. Left gastric artery (12 individuals – 4%) was the commonest source of origin of aberrant left hepatic artery followed by celiac artery (7 individuals – 2.33%), aorta (5 individuals – 1.66%) and superior mesenteric artery (3 individuals – 1%).

DISCUSSION

Anatomical variations of the hepatic artery are crucial for surgery (including liver transplant surgery) and abdominal radiological interventions. These variations increase the risk of arterial injury and, consequently, of severe hepatic ischemia, complications in liver abscess drainage procedures, biliary fistula, or haemorrhage. Hence, accurate identification of variant arterial anatomy can increase the likelihood of surgical success and decrease in rate of post-surgery complications.[9] Sureka et al[10] their study found that 89.34% individuals had origin of right hepatic artery from common hepatic artery while 5.5% individuals had aberrant origin. Accessory right hepatic artery was found in 5.16% of individuals. Corresponding figures in the study by Michels et al.[11] were 88%, 7% and 5%. Our study also showed nearly similar incidence with corresponding figures being 89%, 8% and 3%.

In our study, the patients had some variation in the anatomy of the hepatic artery, compared with 33.2% reported by Gumus et al.[12], 45% reported by Sureka et al.[10], 49% reported by Chen et al.[2], 27% reported by Sebben et al.[6], 23.18% reported by Freitas et al.[14], 10.2% reported by Chen et al.[2], and 21.7% reported by Araujo-Neto et al.[13] The most common anatomical pattern of variation in our study was the right hepatic artery emerging from the superior mesenteric artery. In the studies analyzed, that was also the main pattern of anatomical variation, although in different proportions of the samples evaluated. Gumus et al.[12], reported that same pattern in 10.1% of the patients in their sample, comparable to the 11% reported by Sureka et al.[10], the 15% reported by Chen et al.[2], the 10% reported by Sebben et al.[6], and the 11.38% reported by Freitas et al.[14]

Sureka et al[10] their study found that 88% individuals had origin of left hepatic artery from common hepatic artery while 7% individuals had aberrant origin. Accessory left hepatic artery was found in 5% of individuals. Corresponding figures in the study by Michels et al.[11] were 84%, 9% and 7%. Our study also showed nearly similar incidence with corresponding figures being 86%, 9.7% and 4.3%. Origin of accessory right hepatic artery was found from superior mesenteric artery in 5.16% individuals and from celiac artery in 2.5%individuals in the study

done by Sureka et al.[10] the corresponding figures in our study were 2% and 1% respectively. It is noteworthy that some isolated studies have analyzed the anatomical pattern of the hepatic artery and its branches in cadavers and during liver transplantations. However, studies dealing with the anatomical variations of the hepatic artery are really quite different that distinguishes it from others in the literature.[2,14-16]

In a study by Sureka et al[10], superior mesenteric artery was the commonest (10%) source of origin of aberrant right hepatic artery followed by gastroduodenal artery (2.5%), celiac artery (1.8%) and aorta (0.11%). In our study also we found superior mesenteric artery and gastroduodenal artery were the commonest source of aberrant right hepatic artery with incidence of 3% each followed by celiac artery (1.33%) and aorta (1%). In a study by Sureka et al[10], left gastric artery was the commonest (10%) source of origin of aberrant left hepatic artery followed by celiac artery (7%) and aorta (5%). In our study also we found left gastric artery (4%) being the commonest source of aberrant left hepatic artery followed by celiac artery (2.33%) and aorta (1.66%).

CONCLUSION

In conclusion hepatic artery variations must be taken into account during surgical resection, interventional procedures and transplantation. Knowledge of CT variation prior to these procedures can reduce the incidence of post-operative complications. These variations should be described precisely in the radiological report prior to surgical and interventional radiology procedures.

CASE IMAGES

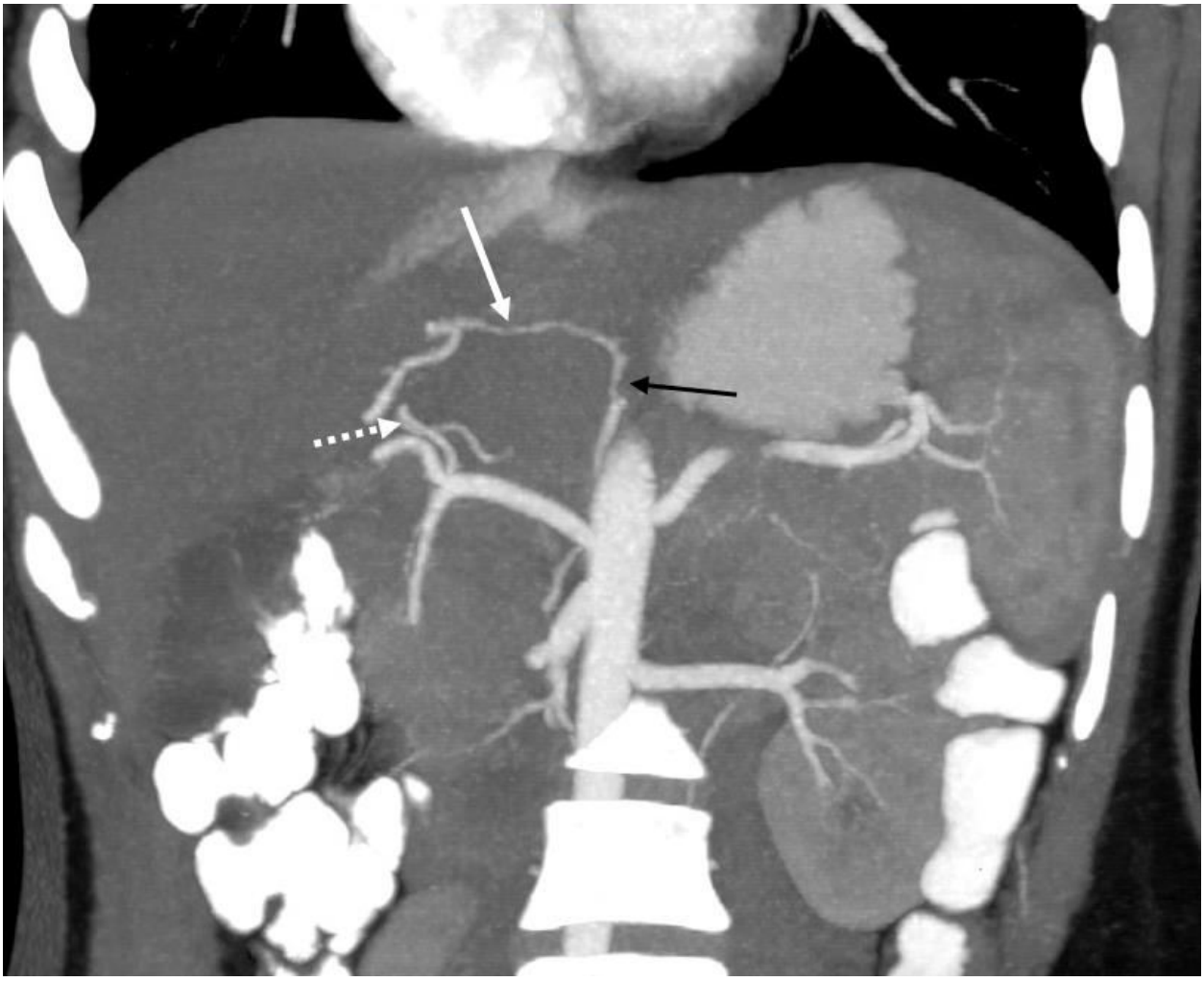

Figure 1: In the CECT abdomen reformatted coronal image, accessory left hepatic artery (white arrow) is seen originating from left gastric artery (black arrow), while separate left hepatic artery (dotted white arrow) is seen originating from common hepatic artery.

Figure 2: In the CECT abdomen reformatted coronal image, aberrant right hepatic artery (black arrow) is seen originating from superior mesenteric artery (white arrow).

Figure 3: In the CECT abdomen reformatted coronal image, aberrant right hepatic artery (white arrow) is seen originating from abdominal aorta (black arrow).

Figure 4: In the CECT abdomen reformatted coronal image, aberrant left hepatic artery (white arrow) is seen originating from left gastric artery (black arrow).

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