

## ORIGINAL ARTICLE

## Clinical Aspects of Varied Arterial Supply and Accessory Lobes of Liver

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### Abstract

The comprehension knowledge of anatomic variations of arterial supply and accessory lobes of liver play a pivotal role in developing surgical skills for routine laparoscopic cholecystectomy as well as successful complex procedures such as Liver transplantation. The aim of the study is to establish the importance of the anatomical variations of blood supply of liver and their clinical importance. The present study was carried out on 26 formalin preserved cadavers for routine teaching purposes and recording observations. The knowledge of anomalous arterial supply and accessory lobes of liver could avoid intraoperative bleeding during hepatic and Peripancreatic surgery. It is also helpful in selecting donors for Liver transplantation.

### Keywords

Accessory Left Hepatic Artery, Accessory Lobes, Living Related Liver Transplantation

### Introduction

The arterial supply to Liver during early gestational period is from three main sources:-

- The left hepatic artery from left gastric artery.
- The middle hepatic artery (Common hepatic artery) from the celiac trunk.
- The right hepatic artery from superior mesenteric artery.

With further development the blood supply assumes the adult pattern. The embryonic right and left hepatic arteries atrophy, the middle hepatic artery (the adult common hepatic artery) take over the blood supply of whole Liver. This pattern occurs in 67% of individuals (1). The variations that occur are:-

- The common hepatic artery (C.H.A) supplying the right hemiliver and left hepatic artery arising from the left gastric in 8%.

- The C.H.A supplying the left liver and the right hepatic arising from the superior mesenteric artery in 11%.

- Persistence of all the three arteries in 3%.
- Atrophy of C.H.A in 12% with the whole liver supplied by right hepatic in 9%, left hepatic in 1% and both right and left hepatic arteries in 2%.

A typical hepatic artery arises from the celiac trunk and divides into the three main branches, the right hepatic artery entering the right lobe of the liver, left hepatic artery in the left lobe and the middle hepatic artery entering the quadrate lobe of liver (2). When hepatic artery arises other than the terminal end of celiac trunk, it is considered as aberrant hepatic artery (3). The aberrant hepatic artery may be accessory or replaced but

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for functional consideration all hepatic arteries are essential (4). The term accessory hepatic is used only when the right and left co-exist with the normal celiac right or left hepatic arteries (3). The variant anatomy of the celiac axis is very common and the main cause for its aberrant morphology is the frequency and diversity of origin and distribution of hepatic arteries (5).

Etiology of an accessory hepatic lobe is an error in the formation of endodermal caudal foregut in the third gestational week and segmentation of hepatic bud (6) other causes could be abnormal blood flow to liver caused by thrombosis, vasculitis or congestion could be the cause for benign hepatocellular lesions.

Although the embryonic development of liver is complex and early embryonic organ is multinodular, still accessory lobes of liver are very rare and when present are quite small on the undersurface of liver. They have made their presence known in only a few instances (Fraser)7.

#### **Material and Methods**

The present study was carried out in Government Medical College of Jammu, J&K State by dissecting 26 formalin preserved cadavers for routine teaching purposes and recording observations. Dissection was

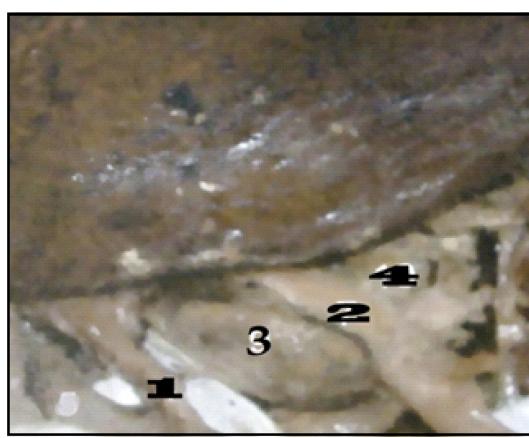
meticulously carried out strictly following instructions given in the Cunningham's manual of practical Anatomy. Observations regarding the arterial pattern of Liver and its relation with lobes of Liver were recorded. Measurements were taken using Vernier Caliper and thread. Appropriate photographs were taken and labeled as shown in *Fig1* and *Fig2*.

#### **Results**

During routine dissection of the abdominal region, an accessory left hepatic artery along with two accessory lobes on the inferior surface of left hemiliver in an adult female cadaver were found. The common hepatic artery was arising from the celiac trunk as usual and further continuing as proper hepatic artery and gastroduodenal artery. Proper hepatic artery followed its usual course at Porta hepatis, divided into right and left hepatic arteries and entered the corresponding lobes (*Fig1*). In addition, a common arterial trunk was arising from the celiac trunk which divided as left accessory hepatic artery (LAHA) and left gastric artery. The left accessory hepatic artery entered the left hemiliver medial to left hepatic artery and it entered the left lobe medial to the left branch of proper hepatic artery.

In between the left hepatic artery and left accessory hepatic artery, an necessary lobe of liver was

***Fig. 1 Showing , Left Hepatic Artery,., Left Accessory Hepatic Artery, Accessory Lobe A and Accessory Lobe B***



present (5cm long). It was connected to the undersurface of liver by a stalk. Another small accessory lobe was present (2 cm long) medial to the left accessory hepatic artery (*Fig2*). Though hepatic arterial variants are common and left hepatic artery arising from left gastric artery has been reported but this is a unique case of duplication of left hepatic artery where a common trunk is dividing into LAHA and left gastric artery.

## Discussion

It has been realized that a comprehensive knowledge of various anatomic variations with regard to arterial supply of liver play a pivotal role in reducing intraoperative bleeding problems during routine hepatic and peripancreatic surgeries and in developing surgical skills for successful complex procedures such as liver transplantation. Introduction of laparoscopic cholecystectomy has stimulated a renewed interest in the anatomy of the hepatic artery as vascular injuries are the most lethal technical injuries encountered during this procedure (8). Liver transplantation and Peripancreatic surgery needs extensive adequately based clear appreciation and knowledge of varied blood supply of liver. As the branches of the hepatic arteries supplying the liver are especially end arteries therefore, in the context of a liver transplant, all anomalous arteries should be considered for preservation and revascularization if deemed enough to be anastomosed to avoid ischemic, pancreatic and biliary tract complications. The knowledge of hepatic arterial variation can also be useful in the selection of donors for partial hepatic grafts in living related liver transplant (LRLT). LRLT procedure is controversial as it entails performing a much larger operation on the donor. Bramstedt (9) has addressed the problem of donor mortality and at least 14 cases were found. With the recent advances of non invasive imaging living liver donors usually have to undergo imaging examinations before donation. MDCT (multi detector row

computed tomography) is good in vascular anatomy and volumetry. Donors with unusual anatomy like the present case could be screened out to avoid unnecessary operation by angiography, Axial CT, And/Or DCEMRI. Moreover the preoperative knowledge of anomalous vessels is also helpful for modification of surgical approach both in donors as well as recipient.

The fact that liver tumors derive their blood supply primarily from the hepatic artery rather than the portal venous system is used in intraarterial infusion of chemotherapeutic agents. The existence of such an arterial variant in patients with liver metastasis carries the risk of misperfusion of intraarterial chemotherapeutic agents delivered by intrahepatic arterial infusion pumps (10). The intraarterial technique for isolated non respectable liver metastasis achieves complete perfusion of whole liver in patients with classical arterial anatomy. Patient having variant arterial anatomy need vascular reconstruction prior to intra- arterial chemotherapy or the use of double port pumping for ideal uniform perfusion (11) . In case of aberrant left hepatic artery, dissection of left gastric and left hepatic artery to ligate all collateral vessels is very very difficult. Misperfusion can be detected by using pump scintigraphy and therefore patient should be monitored with  $^{99m}\text{Tc}$  macroaggregated albumin perfusion studies to ensure successful delivery of chemotherapeutic agents and to avoid serious clinical complications cast by inadvertent perfusion of other organs. An aberrant hepatic artery may cause by potential error in the angiographic diagnosis of traumatic liver haemotoma (12). Adequate knowledge of peripancreatic arterial anatomy is also essential for satisfactory resection of pancreatic tumors

Accessory lobes of liver are rare and most cases remain undetected since they do not cause symptoms. However they can give rise to various clinical symptoms like recurrent abdominal pain and impaired liver function (13). It is important for radiologist to be aware of this

entity as a cause of recurrent right upper quadrant acute abdominal pain. Though rare, routine inspection of vascular and biliary drainage of the liver as part of the check list while evaluating all CT abdominal examinations will alert the radiologist to this diagnosis when a mass is present in the right upper quadrant(14). Rarely an accessory lobe can undergo torsion and present as an acute surgical emergency. The preoperative utility of CT scan and MRI in the diagnosis and surgical plan of a case of intermittent accessory hepatic lobe torsion is highly emphasized. In a study, left hepatic artery had its origin from the common hepatic arterial trunk in 144 instances (80%), from the left gastric artery in 27 instances (15%), the splenic artery in four (2%), the gastroduodenal in two (1%) and one each in the aorta, celiac axis and superior mesenteric artery (15).

### **Conclusion**

In the present study, left hepatic artery had its origin from the common hepatic arterial trunk in 25 cases and one with the anomalous origin along with accessory lobes is reported for the first time. Such variations if recognized during cadaveric dissection provide an alternative perspective to view common morphology and its structural and functional importance. These impart the concept of patient individuality and subsequent individualization of medical and surgical therapies.

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