

# ANOMALOUS ORIGINS OF HEPATIC ARTERY AND ITS SIGNIFICANCE FOR HEPATOBILIARY SURGERY

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## ABSTRACT

An intact hepatic artery is the gateway to successful hepatobiliary surgery. Introduction of laparoscopic cholecystectomy has stimulated a renewed interest in the anatomy of the hepatic artery. Division or damage with subsequent thrombosis produces ischaemia of the liver or bile duct which can have devastating consequences for the patient. Surgeons undertaking hepatobiliary surgery must know their hepatic artery anatomy and be able to recognize the multiple variants for safe surgery and low morbidity. In this study sixty cadavers were studied. This descriptive study was carried out to document the normal anatomy and different variations of the hepatic artery. This study revealed that in nearly 45% of dissections an anomalous variation of the right or left hepatic arteries was found. It also demonstrates that variations when present are often multiple; 40% of anomalous right hepatic arteries had more than one variation present, and 70% of anomalous left hepatic arteries had other variations. In 27% of dissections more than two variations were present.

**Key-words:** Hepatic artery, Superior mesenteric artery, Coeliac trunk, Gastroduodenal artery, Hepatobiliary surgery.

## INTRODUCTION

Usually right and left hepatic artery arises from the proper hepatic artery but it can arise from another artery like common hepatic, superior mesenteric, left gastric etc. So its anatomical variations contribute to misinterpretation and leads to major postoperative complications (Hiatt JR et al, 1994)<sup>1</sup>. A look at the basic anatomy is therefore important for hepatobiliary surgery. The anatomy of the hepatic artery, and its variants, has been described adequately in the literature starting with Haller in 1756 (coeliac axis variations)<sup>2</sup>, Tidemann in 1822 (multiple anomalies)<sup>3</sup>, Adachi in 1928 (28 subgroups)<sup>4</sup>, classic analyses by Flint, (1923)<sup>5</sup>. A new emphasis was given to this anatomy by the introduction of liver transplantation (Todo S et al, 1987)<sup>6</sup>. The arterial patterns are of importance in planning and performance of all surgical and radiological procedures in the upper abdomen. However, surgical mistakes from failing to appreciate hepatic artery anatomy continue to be made with serious consequences to the patient, and with medico-legal implications. This article re-emphasizes the importance of identifying the

anatomy and variations of the hepatic artery.

## MATERIAL & METHOD

This study was carried out over sixty cadavers. After adequate embalming abdominal wall is opened and arterial supply of liver, gall bladder and branches of coeliac trunk, superior mesenteric artery and inferior mesenteric artery are studied, for any variation related to arterial supply of hepatobiliary system. This

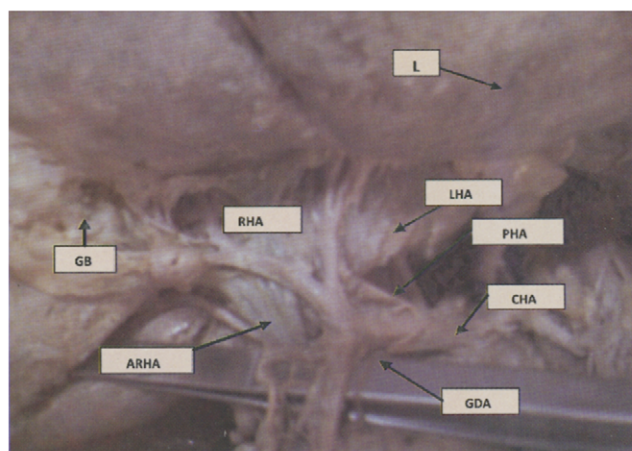


Figure1 : Origin of accessory of right hepatic artery from gastroduodenal artery.

L-Liver , CHA-Common Hepatic Artery ,PHA-Proper Hepatic Artery , RHA-Right Hepatic Artery ,LHA-Left Hepatic Artery ,ARHA- Accessory Right Hepatic Artery, GDA-Gastroduodenal Artery, GB-Gall Bladder.

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study was done from 2003 to 2009 at Department of Anatomy, L.L.R.M Medical college Meerut, Govt. Medical College, Surat and Era's Lucknow Medical College, Lucknow.

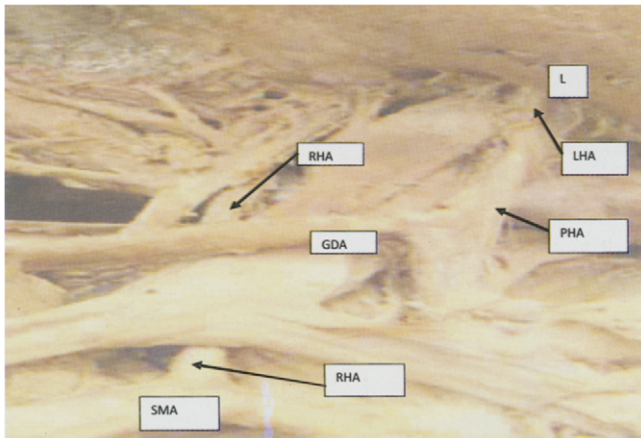


Figure2 : Origin of accessory of right hepatic artery from Superior mesenteric artery.

L-Liver ,PHA-Proper Hepatic Artery , RHA-Right Hepatic Artery ,LHA-Left Hepatic Artery ,GDA-Gastrooduodenal Artery, SMA- Superior mesenteric artery

**OBSERVATION**

The right hepatic artery took origin from the proper hepatic artery in 65% of cases [Table-1], the common hepatic artery in 20% of cases, the superior mesenteric artery in 8.3% of cases ( figure 2) or the celiac trunk in 6.6% of cases. 3 cases of accessory right hepatic artery [Table-2] originating from the superior mesenteric artery (1case) and gastroduodenal artery (2 cases) was observed (figure 1).

The origin of the left hepatic artery [Table-1] included the proper hepatic artery in 71.6% of cases, the common hepatic artery in 16.7% of cases, the coeliac trunk in 10% of cases and the splenic artery in 1.7% of cases. The accessory left hepatic artery [Table-2] originated from the common hepatic artery (2cases), right hepatic artery (1 case) and the coeliac trunk (1 case). An extrahepatic branch to the quadrate lobe of the liver, also known as the middle hepatic artery, was observed in 47.3% arising mainly from the right or left hepatic arteries (20% each), the superior mesenteric artery (2.7%) and from the gastroduodenal artery

Hepatic artery	Site of origin	N=60	%
Right Hepatic artery	Proper hepatic artery	39	65
	Common hepatic artery	12	20
	Superior mesentric artery	5	8.3
	Celiac artery	4	6.7
Left Hepatic artery	Proper hepatic artery	43	71.6
	Common hepatic artery	10	16.7
	Celiac trunk	6	10
	Splenic artery	1	1.7

Table-1: Origin of hepatic artery

Accessory hepatic artery	Site of origin	N=60	%
Accessory right hepatic artery	Superior mesentric artery	1	1.7
	Gastroduodenal artery	2	3.3
Accessory left hepatic artery	Common hepatic artery	2	3.3
	Right hepatic artery	1	1.7
	Celiac trunk	1	1.7

Table-2: Origin of Accessory hepatic artery

Site of origin	N=60	%
Right hepatic artery	45	75
Middle hepatic artery	8	13.3
Gastroduodenal artery	4	6.7
Left hepatic artery	3	5

Table-3: Origin of Cystic artery

(4.6%).

The cystic artery [Table-3] mainly arose from the right hepatic artery (75%) but also took origin from the middle hepatic artery (13.3%), gastroduodenal artery (6.7%) or the left hepatic artery (5%). Irrespective of its relationship with the common hepatic duct, the cystic artery passed in the triangle of Calot in 48 cases. There were 6 accessory cystic arteries arising from the right hepatic (3 cases), the middle hepatic (2 cases) or the left hepatic arteries (1 case).

Out of 5 cases of Rt hepatic artery originating from superior mesenteric artery 2 cases has accessory Rt hepatic artery and 1 case has cystic artery originating from gastroduodenal artery. In 12 cases of Rt hepatic artery arising from common hepatic artery 1 case has accessory Rt hepatic artery, 2 cases has Lt hepatic artery arising from common hepatic artery and 3 cases has variation of origin of cystic artery (arising from middle hepatic artery and Lt hepatic artery).

Out of 10 cases of Lt hepatic artery arising from common hepatic artery 2 cases has Rt hepatic artery arising from common hepatic artery, 2 cases has accessory Lt hepatic artery and 5 cases has cystic artery arising from Lt hepatic artery or gastroduodenal artery.

In 13 cases out of 60 dissections more than two variations are present like anomalous origin of Rt and Lt hepatic artery with variation in origin of cystic artery or with Rt or Lt accessory hepatic artery.

## DISCUSSION

This study shows that there is a pattern to the variations of the hepatic artery, even though the possibilities of individual variations are not uncommon. When the right hepatic artery does not arise from the proper hepatic artery or common hepatic artery, its origin is shifted to aorta or any of the arteries whose normal course is towards right side of the aorta like superior mesenteric, gastroduodenal, right gastric or coeliac trunk.

Left hepatic artery has the same pattern, when the left hepatic artery does not arise from the proper hepatic artery or common hepatic artery, then there is shifting of origin from this artery to arteries who has its course towards Lt side of aorta like splenic artery, left gastric artery or left side of the aorta itself.

The variable pattern of arteries can be explained by embryology. The arterial supply to the liver in early gestation life is from three main sources: the left hepatic artery from the left gastric artery; the middle hepatic artery or common hepatic artery from the

celiac trunk; and the right hepatic artery from the superior mesenteric artery (Couinaud, 1989) 7. With further development, the blood supply assumes the adult pattern, with atrophy of both the right and left hepatic arteries and the common hepatic artery (middle hepatic) supplying the whole liver. This adult pattern occurs in around 67% of individuals. The common hepatic artery gives the right and left hepatic arteries, which supply the right and left hemi-liver, respectively. In 90% of cases, segment 4 is supplied by a named branch (middle hepatic) from either the right or left hepatic artery (45% each) (Michels NA, 1951) 8. The other variations that occur are

□ The common hepatic supplying the right liver and the left hepatic arising from the left gastric in 8%

□ The common hepatic supplying the left liver and the right hepatic arising from the superior mesenteric artery in 11%.

□ Persistence of all three arteries in 3%.

Atrophy of the common hepatic artery in 12%, with the liver supplied by the:

right hepatic (superior mesenteric artery) in 9%

left hepatic (left gastric artery) in 1%

both right and left in 2%. (Northover IM, Terblanche J, 1978) 9.

A study conducted by Aswini K Pujahari 10 in Bangalore, revealed the presence of anatomical variation of hepatic artery in 20.4% cases of liver donors. Here, common variations include a replaced or accessory right hepatic artery originating from superior mesenteric artery (6.67%) and a replaced or accessory left hepatic artery, originating from left gastric artery (6.41%).

## CONCLUSION

This anatomic report demonstrates an anomalous variation of the right or left hepatic arteries in nearly 45% of dissections. It also demonstrates that variations when present are often multiple; 40% of anomalous right hepatic arteries had more than one variation present, and 70% of anomalous left hepatic arteries had other variations. When there were variations, 27% had more than two variations. In this study in 6.7% cases Rt hepatic artery is arising from coeliac trunk and in 10% cases Lt hepatic artery is arising from coeliac trunk which is more than incidences documented earlier.

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