Evaluation Of Branching Pattern Of Hepatic Artery
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Citation

Abstract
The incidence of normal hepatic arterial anatomy ranges between approximately 50-80% of individuals. Knowing anomalous origin of hepatic arteries is important for successful cholecystectomy, hepatobiliary and liver transplant surgery. The present work is a descriptive study which emphasizes to document the normal anatomy and different variations of extra hepatic biliary apparatus and was conducted in Department of Surgery and Anatomy, LLRM Medical College, Meerut and SIMS, Hapur. The study revealed that in all cases, the division of proper hepatic artery was extra-hepatic, of which 92% the point of division was proximal to the point of union of hepatic duct, whereas in 8% cases the point of division was higher. In 86%, the right hepatic artery was dorsal to the common hepatic duct. In 4% cases the artery crossed ventral to common hepatic duct. In 93.5% cases branching pattern of common hepatic artery was normal, 1.5% cases showed trifurcation of common hepatic artery with absence of proper hepatic artery, and aberrant or accessory hepatic artery was present in 5% cases. CONCLUSION: familiarity with vascular Anatomy of sub hepatic region is useful for planning and conduct of radiological as well as surgical procedures of upper abdomen including laparoscopic operations of biliary tract.

INTRODUCTION
Knowledge of variations of CHA may be important in cholecystectomy, pancreaticoduodenectomy, as well as during hepatic artery infusion chemotherapy. Volpe et al reported that injuries to hepatic arterial supply are more likely to be involved in pancreaticoduodenectomy, especially in the region of porta hepatitis. The presence of variations of the normal hepatic artery anatomy is found in 50 to 80% patients. These variations may predispose patients to inadvertent injury during open surgical procedures or percutaneous interventions. The aim of this study was to study the branching pattern and surgical in situ relation of hepatic artery.

Common hepatic artery arises from celiac trunk and divides into gastro duodenal and hepatic artery proper. Hepatic artery proper divides into left and right hepatic artery (Williams et al., 1996). Aberrant left hepatic artery may arise from the left gastric/ celiac trunk directly / right hepatic / splenic artery / superior mesenteric/ gastro duodenal or aorta (Hollinshed and Rosse. 1985). A new emphasis is given to this by the introduction of liver transplantation hence the present study.

MATERIAL AND METHOD
The present study was conducted on 59 individuals undergoing hepatobiliary surgery, after informed consent, in the Department of Surgery and on 30 cadavers in the Department of Anatomy, LLRM Medical College Meerut, and Sarswathi institute of Medical Sciences, Hapur during September 2004 to May 2011. 9 cases were excluded as they shared malignant changes and altered HBA. For the cadaveric study, the structures of the extra hepatic biliary apparatus and vascular system were carefully cleaned and variations systematically observed. For surgeries of open cholecystectomy right paramedian incision was used and the components of extra hepatic biliary apparatus were examined.

OBSERVATION
The proper hepatic artery divided into its terminal branches extrahepatically, in all the cases. In 92% i.e. 73 cases, the point of division of proper hepatic artery was lying proximal to the point of union of hepatic ducts and the division of portal vein. However, in 8% i.e. 7 cases the division of proper hepatic artery was closer to porta hepatitis i.e. distal to the union of hepatic ducts and the division of portal vein (figure :1).

In 78% i.e. 63 cases, the proper hepatic artery was seen to lie ventral to portal vein (figure 2a), in 18% i.e. 14 cases to the left of portal vein (figure 2b), and to the right of portal vein in 4% i.e. 3 cases (figure 2c). The proper hepatic artery was
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found to lie to the left of duct system in 96% i.e. of specimens and to the right in 4% cases.

The right hepatic artery was found to enter the cysto-hepatic triangle; by passing dorsal to the common hepatic duct in 86% i.e. 69 cases (figure 3b). In 4% i.e. 3 cases the artery crossed ventral to common hepatic duct (figure 3a & 3c) and then turned upward, between the cystic and right hepatic ducts to enter the right lobe of liver. However in 10% i.e. 8 cases, the right hepatic artery was situated to the right of common hepatic duct.

Regarding the position of right hepatic artery, in the cysto-hepatic triangle, most frequently i.e. in 80% i.e. 64 of cases, it lies midway between cystic duct and right hepatic duct, next common position of the artery is close to cystic duct in 15% i.e. 12 cases and least frequently, the artery lies close to the right hepatic duct in 5% i.e. 4 of cases (figure 3a)

In majority of cases (75% i.e. 60 cases), the right hepatic artery was found to lie midway between cystic duct and right hepatic duct. The artery was seen to run close to cystic duct in 20% i.e. 16 cases and close to right hepatic duct in 5% i.e. 4 cases (figure 4).

In 93.5% i.e. 75 cases branching pattern of common hepatic artery was normal, but in one case (i.e. 1.5%) proper hepatic artery was absent, and common hepatic artery trifurcated into right and left hepatic artery and gastroduodenal artery (figure 5). In 5% i.e. 4 cases left & right aberrant hepatic artery was found, left aberrant hepatic artery was arising from proper hepatic artery and ran to supply the caudate lobe & right aberrant hepatic artery arose from right hepatic artery to supply the right lobe (figure 6). Right & Left aberrant hepatic artery was accessory because both right & left hepatic arteries were of normal origin, i.e. both lobes of liver had also received normal supply of blood. In one case aberrant left hepatic artery was arising from common hepatic artery to supply the caudate lobe.

Figure 1
Figure 1: PHA divides at Porta Hepatitis

![Figure 1](image_url)
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**Figure 2**
Figure 2a: PHA ventral to PV (78%)

**Figure 3**
Figure 2b: PHA left to PV (18%)
**Figure 4**
Figure 2c: PHA right to PV (4%)

**Figure 5**
Figure 3a: RHA ventral to CHD (4%)
**Figure 6**
Figure 3b: RHA dorsal to CHD (86%)

**Figure 7**
Figure 3c: Showing the Right Hepatic Artery ventral to the Common Hepatic Duct. (CHD-Common Hepatic Duct; CD-Cystic Duct; CBD- Common Bile Duct; GB- Gall Bladder; LHA- Left Hepatic Artery; RHA- Right Hepatic Artery; PHA- Proper Hepatic Artery; GDA- Gastro Duodenal Artery; RAHA- Right accessory hepatic artery; LAHA- Left accessory Hepatic Artery.)

**Figure 8**
Figure 4: RHA in relation to CD & RHD
Figure 9
Figure 5: Shows Trifurcation of common hepatic artery. (BD- Bile Duct; LHA – Left Hepatic Artery; RHA- Right Hepatic Artery; CHA- Common Hepatic Artery; GDA- Gastro Duodenal Artery; LGA- Left Gastric Artery; SA- Splenic Artery)

Figure 10
Figure 6: Showing Accessory Hepatic Artery arising from Common Hepatic Artery. (CBD- Common Bile Duct; CD- Cystic Duct; GB- Gall Bladder; LHA- Left Hepatic Artery; RHA- Right Hepatic Artery; PHA- Proper Hepatic Artery; GDA- Gastro Duodenal Artery; AHA- Accessory Hepatic Artery;)

DISCUSSION
In present study, in all cases proper hepatic artery divided into its terminal branches extrahepatically, of which 92% the point of division was proximal to the point of union of hepatic duct, whereas in 8% cases the point of division was higher, these findings were well in accordance with the reports of Almenar-Garcia (1993) 10.

In the present study, the proper hepatic artery was seen to lie ventral to portal vein and to the left of duct system, in majority of specimens. This finding is quite in agreement with the observation mentioned in the report 11-12.

According to Daseler et al, (1947) 13, in cysto-hepatic triangle, common hepatic duct was dorsal to right hepatic artery in about 20% cases which is quite higher than the present study where the same was observed in 10% of cases.

In the cysto-hepatic triangle, the close contact of right hepatic artery and cystic duct is encountered in 20% of the present series, a relationship found in 50% cases as reported earlier by Thompson (1933) 14. This finding is of importance in hepatobiliary surgery.

In present study, total 6.5% variation of branching pattern of the common hepatic artery was observed of which 5% were cases of aberrant or accessory hepatic artery and 1.5% cases of trifurcation of common hepatic artery with absence of proper hepatic artery .Whereas as much as 40% of the total variations of branching pattern of the common hepatic artery have been described by Michels (1953) 15 and 45% by Baum (1983) 16. Abdullah et al. (2006) 1 studied 932 cases of liver transplantation and reported that normal hepatic artery distribution was found in 635 cases (68.1%). Variations of hepatic artery were detected in 297 subjects (31.9%) and Gruttadauria et al. (2001) 4 studied 701 patients and encountered hepatic artery anomalies in 42%.

Presence of both accessory right and left hepatic arteries in conjunction with a proper hepatic artery has been described with a 1% incidence by Almenar-Garcia et al (1993) 10. In his study, Gruttadauria et al. (2001) 4 observed the most common anomaly was a replaced/accessory RHA arising from the SMA in 15% of cases; aberrant hepatic artery may be accessory or replacing artery. If an aberrant artery supplies a lobe of liver which receives also a supply from a hepatic artery of normal origin it is known as an aberrant accessory artery. If however it constitutes a sole blood supply to a lobe of liver, it is known as aberrant replacing artery since it replaces the normal hepatic artery.

The literature suggests that these variations can be explained in terms of developmental basis 17S. During development, the extra hepatic biliary system arises from an intestinal
diverticulum, which carries blood supply from branches of aorta, celiac trunk and superior mesenteric arteries. As the development progresses, most of these vessels are disappeared and pattern of the disappearance is highly variable. This explains the reason for the sub hepatic variations. The surgeon and interventional radiologists need to be aware of the possibility for such anatomical variations in order to avoid potentially disastrous complication.

CONCLUSION

The present was a random study conducted to observe the arterial pattern supplying the extra hepatic biliary apparatus in the western u.p. population but still further research continuing in this field. A good knowledge of arterial system of liver and extra hepatic biliary apparatus, distribution and possible anatomical variation is important for surgeons, radiologists and clinicians as it is significant in liver transplantation in order for the vascularity not to be disturbed and necrosis of liver parenchyma postoperatively, nonestablishment of continuity in time of reconstruction is important because of post operative complication such as acute liver failure which can augment morbidity and mortality.

References

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