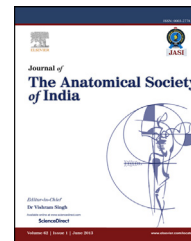


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Original Article

Surgical anatomy of sub-hepatic biliary system



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ABSTRACT

Introduction: The anatomy of liver and extra-hepatic biliary apparatus has always been the focus of attention among anatomists and surgeons. It has gained greater significance in the recent years in view of technical refinements in the field of cholecystectomy, hepatic surgery and transplantation. Present study emphasizes the normal as well as variations of extra-hepatic biliary apparatus, as most of the published work on the surgical anatomy of the extra-hepatic biliary apparatus refers various ethnic groups variations. Literature on this topic in western U.P. subjects is scanty.

Method: A 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 Saraswathi Institute of Medical Sciences, Hapur during September 2004 to May 2011.

Result: The study revealed that in all cases, the union of hepatic ducts was extra-hepatic, of which 10% were angular low union and 5% parallel low union. In 95% cases cystic duct had angular union and 4% had parallel type of union with common hepatic duct and in one case cystic duct united with accessory hepatic duct. 16% cases had short cystic duct i.e. 1–2 cm in length. 94% cases show usual relation in hepatoduodenal ligament and in 6% common bile duct was to the left of hepatic artery.

Discussion: The obtained results presented variations regarding certain parameters when compared to previous studies and they represent the ethnic parameters of western UP.

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1. Introduction

It is recognized that misidentification of normal anatomy, as well as the presence of anatomical variations, contributes to the occurrence of major postoperative complications, especially biliary injuries.¹ Such injuries can in turn cause significant morbidity and occasionally even mortality. Sound knowledge of the normal anatomy of the extra-hepatic biliary tract, as well as the surgical implications,² is thus essential to prevent these complications.

The extra-hepatic biliary apparatus consists of the gallbladder, a piriform sac partly contained in a fossa on the inferior surface of the right hepatic lobe, two ducts (the right and left hepatic duct) ensuing from the liver and uniting near the right end of the porta hepatis to form the common hepatic duct, which passes downwards for about 3 cm, and joined on its right side at an acute angle by the cystic duct (usually 3–4 cm long) immediately below the porta hepatis; by the union of the common hepatic with the cystic duct the bile duct is formed. The common hepatic duct is on the right side of the hepatic artery and in front of the portal vein.

Present study emphasizes the normal as well as variations of extra-hepatic biliary apparatus, as most of the published work on the surgical anatomy of the extra-hepatic biliary apparatus refers to various ethnic groups variations. Literature on this topic in western U.P. subjects is scanty and hence present study was undertaken.

2. 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 Saraswathi institute of Medical Sciences, Hapur during September 2004–May 2011. Due to malignant changes and altered HBA, 9 cases were excluded. 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.

3. Results

In all the cases (100%) gallbladder was normally present in the right hypochondrium and it was partly sunken in a fossa for the gallbladder on inferior surface of the right hepatic lobe. In 97.5% (78) of cases gallbladder was normal in shape and size. But in 2.5% (2) of cases bifid gallbladder was found during cholecystectomy.

The right and left hepatic ducts were found to unite extrahepatically in all the cases. In 85% (68) of cases the union of right and left hepatic ducts was found to be the highest i.e., 1 cm below porta hepatis, and in 10% cases i.e. 8 cases right and left hepatic ducts run almost parallel to each other for 2.5 cm before union and in another 5% cases i.e. 4 cases also

displayed lower union of right and left hepatic ducts but forming a wide angle.

In cysto-hepatic triangle the common hepatic duct was found ventral to the right hepatic artery in 86% cases. However in 4% cases common hepatic duct was dorsal to the right hepatic artery (Fig. 1) and in 10% cases, common hepatic duct was situated to the left of the right hepatic artery.

Further, in 95% cases i.e. 76 cases the union of cystic duct with common hepatic duct was angular type, and in 3.7% i.e. 3 cases cystic duct with common hepatic duct was in parallel form it was united with common hepatic duct behind the first part of duodenum (Fig. 2) but one case (1.25%) showed accessory hepatic duct issuing from the right side of porta hepatis and the cystic duct, in this case, united with the accessory hepatic duct which in turn united with common hepatic duct 1 cm below the porta hepatis.

The variation in the length of the cystic duct was also observed. The length of cystic duct was usually 3–4 cm in most of the cases, but in 16.2% i.e. 13 cases it was very short (about 1–2 cm) in length.

In hepatoduodenal ligament the bile duct and hepatic artery were found to lie anterior to portal vein; hepatic artery being the left and bile duct being the right structure in 94% cases i.e. 75 cases. While in 6% cases i.e. 5 cases, bile duct was present on the left side and hepatic artery on the right side.

Regarding the arrangement of structures at the porta hepatis, the portal vein was the most posterior structure and hepatic ducts were in the most anterior plane with the hepatic arteries occupying an intermediate position.

4. Discussion

In present study gallbladder was present in the fossa of the gallbladder, on the inferior surface of right lobe of liver in 100% cases. Interestingly in one case, bifid gallbladder was found during open cholecystectomy during the present study, whereas in earlier studies the incidence of bifid gallbladder has been reported as 1 per 4000–5000 persons.³ A number of

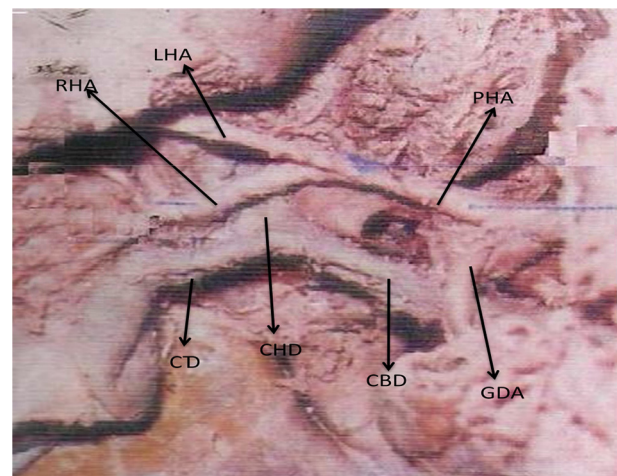


Fig. 1 – Common hepatic duct dorsal to the right hepatic artery (CHD – common hepatic duct; CD – cystic duct; LHA – left hepatic artery; RHA – right hepatic artery; PHA – proper hepatic artery; GDA – gastro duodenal artery).

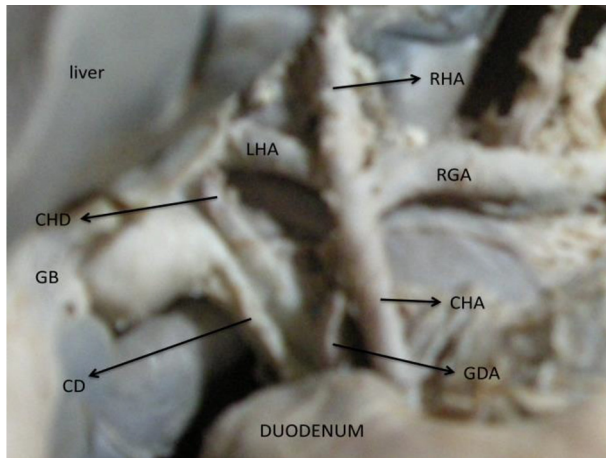


Fig. 2 – Shows parallel low union of cystic duct with common hepatic duct behind the first part of duodenum (CHD – common hepatic duct; CD – cystic duct; GB – gall bladder; LHA – left hepatic artery; RHA – Right hepatic artery; CHA – common hepatic artery; GDA – gastro duodenal artery; RGA – right Gastric artery).

researchers have defined duplication of gallbladder.^{4–6} The bifid gallbladder was drained by single cystic duct in the present study, while during an earlier study³ in 28 cases out of 19,000 examinations of cadavers and patient's two cystic ducts were reported.

The union of right and left hepatic ducts took place extra-hepatically in all the cases in the present study. This finding is at slight variance with that Thompson,⁷ where the extra-hepatic union was seen in 90% cases.

In comparison to hepatic artery and portal vein, the union of the two hepatic ducts was observed to be the highest, lying closest to liver, a finding well in accordance with Mizumoto and Hideakisuzuki.⁸

In the present study, the union of right and left hepatic ducts is seen close to liver in 85%, i. e. 68 cases making an acute angle and in 5% cases i. e. 4 cases, the two ducts united at a distance of 2.5 cm from the porta hepatis making a wide angle. Thus, present study shows angular union of the two ducts in 90% cases i. e. 72 cases, a pattern observed in 75% cases by Eisendrath,⁹ and in 63% cases by Johnston and Anson.¹⁰ In the remaining 10% cases i. e. 8 cases of present study, two ducts ran parallel to each other and united at a distance of 2.5 cm from the porta hepatis. This parallel course of two hepatic ducts was observed in 17% of cases by Eisendrath.⁹

In 1.25% the accessory hepatic duct was observed on the right side in the present study this is close to 2.9% reported by Uchiyama,¹¹ but low in comparison to other studies 9%,¹² 10%¹³ Eisendrath,⁹ has stated that such ducts occur predominantly on the right side which is in agreement with our study. Regarding the communication, the accessory hepatic duct in our series joined the common hepatic duct, Michels¹⁴ in his study found that accessory hepatic ducts predominantly join the common hepatic duct (18%), in 3.5% the right hepatic duct, in 2% the cystic duct and the 1% the common bile duct but in present case, it joined with the common hepatic duct.

In cysto-hepatic triangle the common hepatic duct was dorsal to the right hepatic artery in 4% cases and in 10% cases; it was situated to the left of the right hepatic artery, whereas according to Daseler et al,¹⁵ CHD was dorsal to RHA in about 20% cases.

Junction between the cystic and hepatic ducts varies and is classified into three fundamental groups – the angular type, the parallel type and the spiral type. In the angular type, cystic and hepatic ducts unite at an angle (varying from right angle to acute) and this was observed in 94% cases of present study, in the available literature it has been reported to be 58%,¹⁶ 65%,¹⁰ 75%,^{9,17} parallel type of junction was observed in 4% cases in our study, it has been reported in the range of 1.25–25%,¹⁸ Johnston and Anson¹⁰ found it in 17% cases and spiral type of union was found in 8% cases.

In the present study the length of cystic duct was normal i. e. 3–4 cm in 84% cases i. e. 67 cases, but in 16% cases, cystic duct was short, about 1–2 cm in length. Lichtenstein and Ivy¹⁹ reported that about 55% cystic ducts were 2–4 cm long, 20% less than 2 cm length and 25% more than 4 cm long, which was not found in the present study.

In the present study portal vein, hepatic artery, and bile duct relationship in hepatoduodenal ligament was usual in 94% cases, whereas according to Hollinshed²⁰ 100% of cases showed usual relationship. Interestingly in present study in 6% cases i. e. 5 cases, the hepatic artery was found to be on the right side of the bile duct.

Regarding the arrangement of structures at the porta hepatis, the portal vein was the most posterior structure and hepatic ducts were in the most anterior plane with the hepatic arteries occupying an intermediate position. This observation is in quite agreement with Hollinshed.²⁰

5. Conclusion

The present work is a random study on small sample size and represents the data of western UP though further work is still required in this field. In modern surgical and transplantation procedures like hepatectomy, segmentectomy and living donor transplantations^{21,22} the recognition of anatomic abnormalities of liver and extra-hepatic biliary apparatus is of greater importance than ever. The surgeon and interventional radiologist need to be aware of the detailed surgical anatomy of sub-hepatic biliary apparatus to help prevent some of the serious accidents or providing favorable therapeutic outcomes.

Conflicts of interest

All authors have none to declare.

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