

Extrahepatic Biliary Apparatus: Anatomical variations and their clinical significance

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ABSTRACT

Background: Variations in the anatomy of extrahepatic biliary apparatus (EHBA) has been a subject of extended research due to its clinical implications. Cholecystectomy is a commonly performed surgical procedure and its safety requires the sound anatomical knowledge of this area:

Aim: To determine the gross anatomical features of gall bladder, extrahepatic biliary apparatus and other structures in the hepatoduodenal ligament.

Methodology: At dissection hall, anatomy department of Sheikh Zayed Medical College, Rahim Yar Khan, a prospective descriptive study was conducted. Twenty five human cadavers of both sexes were included. Cadavers with scars of hepatobiliary surgery, abdominal trauma and cirrhosis of liver were excluded. Gross anatomical features of gall bladder, EHBA and other structures in the hepatoduodenal ligament were studied.

Result: Regarding gall bladder, all twenty five cadavers have a single extrahepatic, gall bladder on the inferior surface of right lobe of liver in gall bladder fossa (100%). Only one (4%) had a mesentery. Twenty four (96%) were pear shaped and one (4%) had a Hartmann's pouch. Angular type of union of cystic duct (CD) with common hepatic duct (CHD) to form common bile duct (CBD) was present in 20 cases (80%) and parallel type in 5 cases (20%). Twenty two cases (88%) showed a normal level of termination of cystic duct, two (8%) showed a high and one (4%) had a low level. Morphologically hepatoduodenal ligament was normal in 24 cases (96%) and one (4%) showed an abnormal structure or arrangement. Accessory cystic and right hepatic ducts were also noted.

Conclusion: Anatomical variations of extrahepatic biliary apparatus are common and their thorough understanding is clinically important for surgeon to avoid iatrogenic injuries during hepatobiliary surgery.

Keywords: Extrahepatic biliary apparatus (EHBA), Cholecystectomy, Gall bladder, common bile duct.

INTRODUCTION

The components of EHBA are right and left hepatic ducts, common hepatic duct (CHD), gall bladder, cystic duct (CD) and common bile duct (CBD). Right and left hepatic ducts carry bile from right and left physiological lobes of liver respectively. They emerge at the porta hepatis anterior to branches of portal vein and hepatic artery. Common hepatic duct (CHD) is formed by the union of right and left hepatic ducts near the right end of porta hepatis. It is 3cm long and is joined by cystic duct to form common bile duct. Gall bladder is a pear shaped fibromuscular sac that stores and concentrates bile. It lies in the gall bladder fossa on the inferior surface of right lobe of liver. Cystic duct begins at the neck of gall bladder and joins common hepatic duct to form CBD. Cystic artery (a branch of right hepatic artery) passes through Calot's triangle which is an important landmark used for locating cystic artery. Its boundaries are superiorly inferior surface of liver, on left common hepatic duct and on right cystic duct. Its contents are cystic artery and lymph node of Lund.

Both anatomically as well as surgically, it is interesting to study the normal anatomy and its variations in the components of extrahepatic biliary apparatus^{1,2}. These variations in course,

confluence and relationship between the structures of EHBA are of great clinical significance. EHBA congenital anomalies are often reported, most of the cases present during adult life and mimic some acquired conditions^{3,4}. Majority of anomalies are often associated with calculus formation and duct dilatation⁵. Variations in cystic and hepatic duct and cystic and right hepatic artery are not uncommon. The anatomical variations are an important reason of iatrogenic injuries to these ducts and vessels, during cholecystectomy and other hepatobiliary surgeries. Failure to recognize the unusual anatomical relationship or accessory ducts may increase morbidity and mortality in surgical patients⁶. Accessory hepatic ducts are normal segmental ducts that join the biliary system outside the liver instead of within it and are at risk of injury during cholecystectomy. Ductal injuries may present as postoperative bile leakage, biliomas, biliary peritonitis and fistula leading to septic shock. Detailed studies of normal anatomy and variations give valuable information to the surgeons to perform safe surgeries with good results and to aid in teaching^{7,8}.

METHODOLOGY

In Dissection Hall, Anatomy Department of Sheikh Zayed Medical College, a prospective descriptive study was conducted on twenty five human cadavers dissected for

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teaching purpose between July 2015 to June 2018. Gross anatomical features of gall bladder (number, position, situation, mesentery & shape) and extrahepatic biliary apparatus (hepatoduodenal ligament, type of union of cystic duct with CHD, level of termination of cystic duct, accessory ducts, cystic and right hepatic artery and Calot's triangle boundaries) were studied.

Inclusion criteria: Macroscopically healthy and undamaged liver with intact gall bladder and other components of EHBA from cadavers of both sexes.

Exclusion criteria: Following livers were excluded from the study.

1. Hepatobiliary surgery.
2. Cholecystectomy.
3. Liver trauma affecting EHBA.
4. Cirrhosis of liver.

RESULTS

All twenty five (100%) cadavers have a single extrahepatic gall bladder on the inferior surface of right lobe of liver in gall bladder fossa. Only one (4%) had a mesentery. Twenty four (96%) were pear shaped and one (4%) had a Hartmann's pouch. (Table-I)

Angular type of union of CD with CHD to form common bile duct (CBD) was present in 20 cases (80%) and parallel type in 5 cases (20%). Twenty two cases (88%) showed a normal level of termination of cystic duct, two (8%) showed a high and one (4%) had a low level. Morphologically hepatoduodenal ligament was normal in 24 cases (96%) and one (4%) showed an abnormal structure or arrangement. Accessory cystic and right hepatic ducts were also noted. Accessory cystic and right hepatic ducts were found in one (4%) and two (8%) cases respectively. Twenty one cases (84%) showed a normal cystic artery, one (4%) double cystic artery, one (4%) an accessory cystic artery and two (8%) had an abnormal course of it. Right hepatic artery was normal in 24 cases (96%) and only one (4%) showed an abnormal course. Calot's triangle boundaries were normal and well defined in 24 cases (96%) and abnormal in one case (4%). (Table-II)

Table-I: Gross anatomical features of gall bladder

Anatomical Features	Details	n
Number	Single	25(100%)
Position	Inferior surface of right lobe of liver	25(100%)
Situation	Extrahepatic in gall bladder fossa	25(100%)
Mesentery of GB	Absent	24(96%)
	Present	1(4%)
Shape	Pear shaped	24(96%)
	Hartmann's pouch	1(4%)

Table-II Gross anatomical Features of EHBA

Hepatoduodenal ligament	n	%age
Type of union of Cystic duct with Common Hepatic Duct (CHD)		
Angular	20	80%
Parallel	5	20%
Level of termination of cystic duct		
Normal	22	88%
High	2	8%
Low	1	4%
Hepatoduodenal ligament		
Normal	24	96%
Abnormal	1	4%
Accessory ducts		
Cystic duct (CD)	1	4%
Right hepatic duct (RHD)	2	8%
Cystic artery		
Normal	21	84%
Double	1	4%
Accessory	1	4%
Abnormal course	2	8%
Right Hepatic artery		
Normal	24	96%
Abnormal course	1	4%
Calot's triangle boundaries		
Normal and well defined	24	96%
Abnormal	1	4%

Fig. I: Gross anatomical features of gall bladder

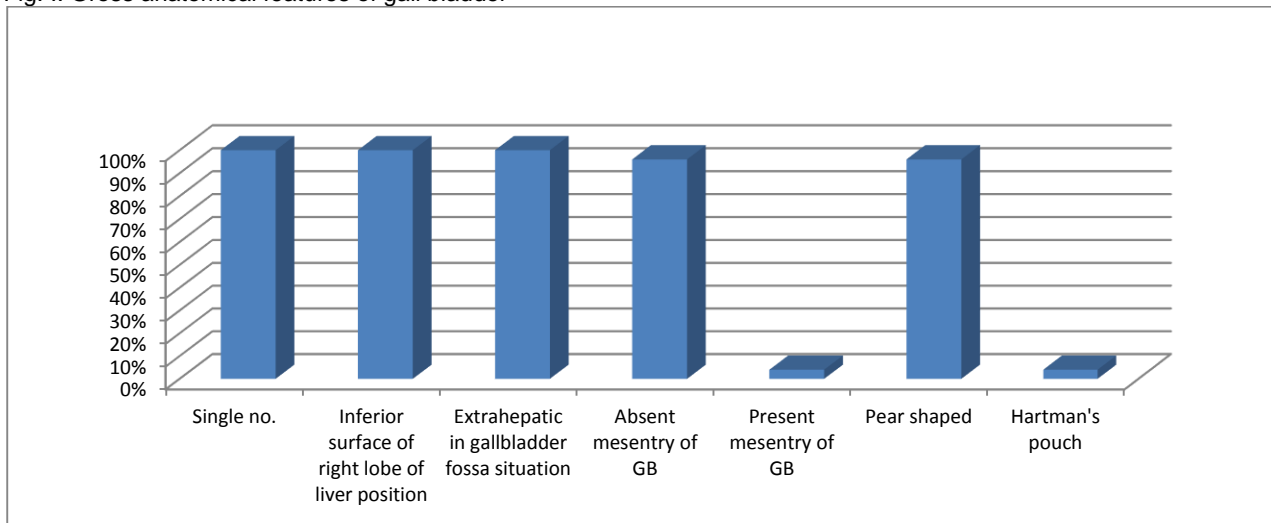
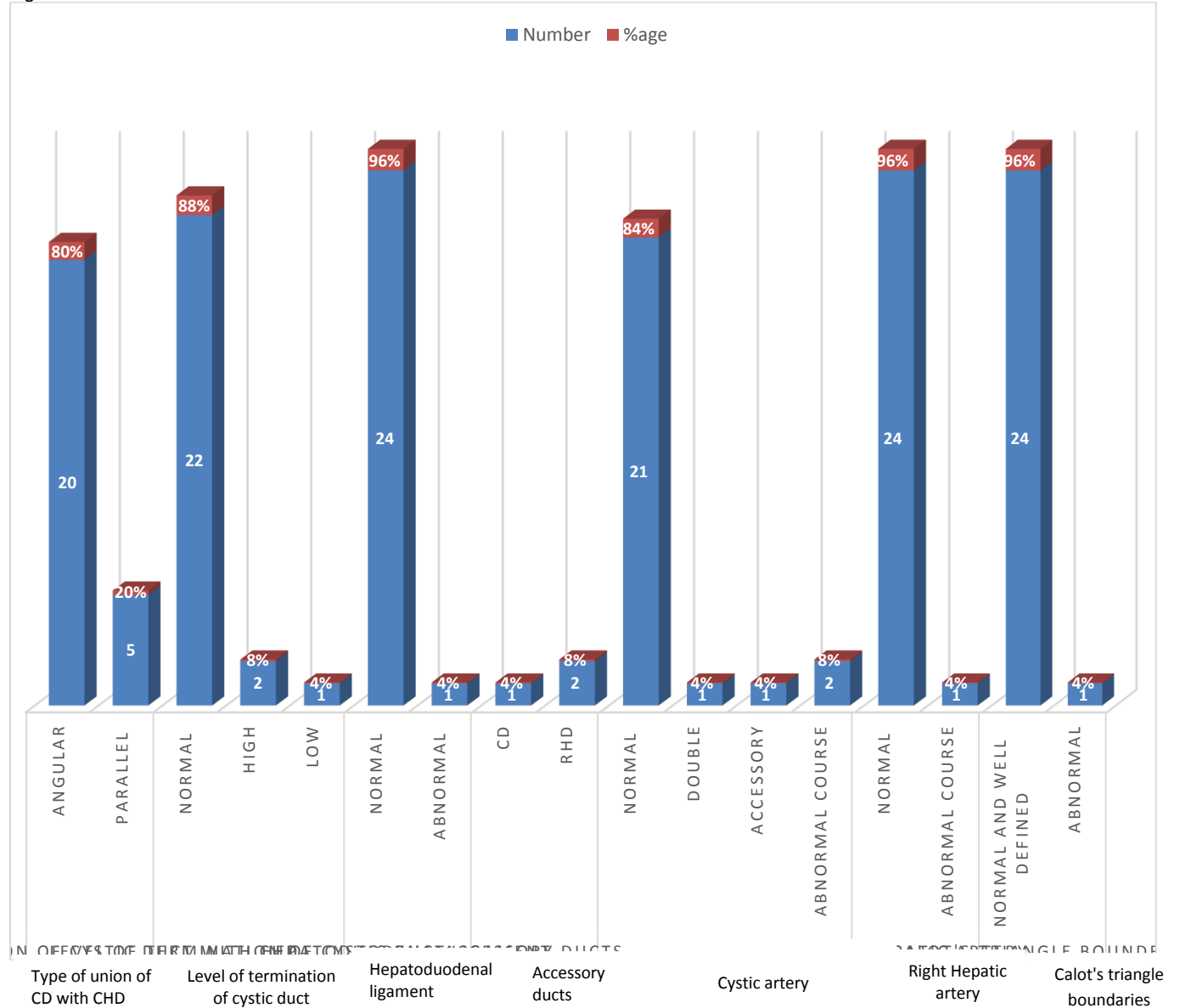


Fig.2:



DISCUSSION

Knowledge and understanding of variations in the anatomy of gall bladder and extrahepatic biliary apparatus is essential for surgeons as failure to recognize them may lead to iatrogenic injuries in laparoscopic cholecystectomy^{9,10}. Incidence of extrahepatic biliary apparatus anatomical variations ranges between 7.3% to 47%^{11,12}. Correct identification of EHBA anatomy and its possible variations is the key to a safe surgical procedure.

In our study, all twenty five cadavers had a single, extrahepatic gall bladder on the inferior surface of right lobe of liver in gall bladder fossa (100%). These findings resemble that of Anandhi. The key abnormality found in the gall bladder is Hartmann's pouch. In this study, it was found in one case (4%). Anandhi also found Hartmann' pouch in 4% cases¹³. Leena AB¹⁴ observed it in 4.3% cases. In

contrast van Eijck found a very high incidence of Hartmann's pouch (52%)¹⁵. Hartmann's pouch may be a frequent but variable feature of both physiologic and pathologic gall bladder and is usually associated with gall stones¹⁵. Mesentery of gall bladder was indentified in one case (4%). Anandhi found no mesentery of gall bladder.

Union of cystic duct to CHD to form CBD was angular type in 80% and parallel type in 20% in our study. Anupama found angular type in 86% and parallel type in 2%. However another type, spiral was present in 12%¹⁶. Descomps¹⁷ and Eisendrath¹⁸ found angular type in 80% and 75% respectively. Level of termination of cystic duct was normal in 88% cases, high in 8% and low in 4% in the present study. Anandhi reported a normal level of termination of cystic duct in 82%, high in 16% and low in 2%. Hepatoduodenal ligament was normal in 96% and 4%

had an abnormal arrangement or contents in our study. This is comparable with Anandhi who found 98% normal and 2% abnormal.

Accessory right hepatic and cystic ducts were present in 12% cases and Anandhi found them in 14%. Double cystic artery and accessory cystic artery were present in 4% each. Eighty four percent cases had normal cystic artery. Similar results were reported by Anadhi. A cystic artery is an important structure to be clipped or ligated in cholecystectomy. The complications like haemorrhage or hepatobiliary injury are because of likelihood of variations in cystic artery course and relations to the biliary ducts¹⁹. In our study right hepatic artery was normal in 96% and only 4% had an abnormal course. It is comparable to Anandhi who found an abnormal course of right hepatic artery in 4% Calot's triangle boundaries were normal and well defined in 96% and only 4% has an abnormal boundary. Anandhi found an abnormal boundary in only 2%. Congenital anomalies and normal variants of biliary tree are not uncommon but are of significant value in surgery as failure to recognize them leads to iatrogenic injuries and increased morbidity and mortality²⁰.

Conclusion: Anatomical variations of extrahepatic biliary apparatus are common and their thorough understanding is clinically important for surgeon to avoid iatrogenic injuries during hepatobiliary surgery.

REFERENCES

- Hicken. Anatomic Variations of extrahepatic Biliary Apparatus. *Surg; Obst; Gynae* 1954;10:577-84.
- Osler.G. & Dow.R. Variations and anomalies of the biliary duct system and its associated blood supply. *West J. Surg* 1945;53:316-21.
- Sandrini. Congenital abnormalities of bile passage. *Arch of surgery* 1944;(1):262-66.
- Brewer. G.E. Anatomy of the Gallbladder region. *Medical news*. 1903;82:821-23.
- Agvey. I.Rogeus. Congenital absence of Gallbladder with Choledocholithiasis. *Gastroenterology*. 1965;48:4.
- Moosman. Anomalies of Biliary tract System. *Surg. Obst, Gynae*. 1970;82:655-62.
- Eisendrath. *Surg, Obst, Gynae*. Operative injury to Common hepatic & Bile Ducts. *Surg, Obst, Gynae* 1920;31:1-18.
- Lurje et al. Topography of extra Hepatic Biliary passage. *Annals of Surgery*, 1937;105:161-168.
- DL N. The biliary system. *Sabiston DC Text Book of Surgery*. 13Ed. Igaku-Shoin: W.B. Saunders company: 1986: 1128-36.
- Suhocki PV. Injury to aberrant bile ducts during cholecystectomy: a common cause of diagnosed error and treatment delay. *Am J Roentgenol*. 1999;72:955-59.
- Lamah M, Dickson GH. Congenital anatomical abnormalities of the extrahepatic biliary duct a personal audit. *Surg Radiol Anat*. 1999;21(5):325-7.
- Dundaraddy MG. Study of Variations in the Extrahepatic Biliary System. *Biomirror J*. 2012;3(3):1.3.
- Anandhi PG, Alagavenkatesan VN. Anatomical variations in the extra hepatic biliary system: a cross sectional study. *Int J Res Med Sci* 2018;6:1342-7.
- Leena AB. Study of Hartmann's pouch in south keralites. *Journal of evolution of medical and dental sciences-JEMDS*. 2015;4(26):4491-5.
- van Eijck FC, van Veen RN, Kleinrensink GJ, Lange JF. Hartmann's gallbladder pouch revisited 60 years later. *Surg Endo*. 2007;21(7):1122-5.
- Anupama D, Shivaleela C, R Lakshmi Prabha Subhash. A Study of Anatomy of Extra Hepatic Ducts and its Variations with Clinical Significance. *Int J Anat Res* 2016;4(1):2029-2033. DOI: 10.16965/ijar. 2016.138.
- Dowdy et al. *Surgical Anatomy of Pancreatic Biliary System*. *Surgery* 1962;108(6):p233-34.
- Daniel.N.Eisendrath. Anomalies of Bile ducts and blood vessels. *Journal of American Medical Association*. 1918;71:864.
- Dandekar DK. Cystic Artery: Morphological Study and Surgical Significance. *Anatomy Res Inter*. 2016;2016:7201858.
- Talpur LA, Yousfani SA, Malik AM, Memon AI, Khan SA. Anatomical variations and congenital anomalies of extra hepatic biliary system encountered during laparoscopic cholecystectomy. *J Pak Med Assoc*. 2010;60(2):89-93.