Journal of Rare Cardiovascular Diseases
ISSN: 2299-3711 (Print) | e-ISSN: 2300-5505 (Online)
www.jrcd.eu
RESEARCH ARTICLE

ANATOMICAL VARIATIONS IN MORPHOLOGY AND MORPHOMETRY OF EXTRAHEPATIC BILIARY APPARATUS - A CADAVERIC STUDY

DR ANURADHA[1], MRS BALWINDER KAUR[2]

[1] Associate Professor, Department of Anatomy, Government Medical College, Patiala, Punjab, 147001.

[2] Msc Student 2nd Yr, Department of Anatomy, Government Medical College, Amritsar, Punjab. 143001.

Article History
Received: 17.09.2025
Revised: 02.10.2025
Accepted: 21.10.2025
Published: 30.10.2025

Abstract: **INTRODUCTION** – Extrahepatic biliary apparatus consists of gall bladder, cystic duct, right and left hepatic ducts, common hepatic duct and common bile duct. Knowledge of anatomy and associated variations related to extrahepatic biliary apparatus is fundamental in order to avoid future errors by surgeons, gastroenterologists and radiologists while performing surgeries, diagnostic and therapeutic techniques. **AIMS AND OBJECTIVES**- To provide detailed data about incidence and type of variations related to extrahepatic biliary apparatus.**MATERIAL AND METHOD-A** cadaveric study done on 50 adult human cadavers of anatomy department of Government medical college, Amritsar. **RESULTS** - In present study's observations, 2 specimens (4%) were having Phrygian cap. In 2 specimens cystic duct ran parallel to common hepatic duct for variable distance before these unite. It was observed that 6% specimens were having multiple cystic ducts. Accessary hepatic ducts were observed in 2% of specimens, and common hepatic duct lie anterior to proper hepatic artery and portal vein. **CONCLUSION**- Present study is having great clinical, Anatomical and surgical significance. It will further prevent the iatrogenic injuries and complications during, and post laparoscopic surgeries.

INTRODUCTION

Extrahepatic biliary apparatus consists of gall bladder, cystic duct ,right and left hepatic duct, common hepatic duct and common bile duct.[1] Knowledge of anatomy and associated variations of extrahepatic biliary apparatus is fundamental in order to avoid future error while performing MRCP by radiologist and laparoscopic surgeries by surgeons.[2] Finding variations in the normal anatomy of extrahepatic biliary apparatus while performing surgeries lead to iatrogenic injuries which includes bile duct injuries, cystic artery related injuries.[3] These constitute 4.7- 7.3% of laparoscopic surgeries of extrahepatic biliary apparatus injuries.[4] Common medical disorders related to extrahepatic biliary apparatus includes cholelithiasis, cholecystitis, gall bladder atresia, malignant neoplasm of the gall bladder. Anomalies related to gall bladder includes disparities in number, location, volume, shape and attachment. In some cases separate duct from liver enter gall bladder. Cystic duct may be absent, gall bladder neck directly empty into bile duct. Proper exposure of calot's triangle and careful identification of boundaries and structures is key to avoid injury to extrahepatic biliary apparatus. Prior knowledge of variations of extrahepatic biliary apparatus is of paramount importance to avoid future complications related to surgeries of extrahepatic biliary apparatus.

AIMS AND OBJECTIVES

To recognise and provide details of morphological and morphometric variations related to extrahepatic biliary apparatus.

To provide details of morphological and morphometric data of extrahepatic biliary apparatus.

MATERIAL AND METHOD

The study done on 50 adult human cadaver of known sex and age from department of anatomy at Government medical college, Amritsar. This study was conducted after taking ethical committee approval (letter no 37515-16/D 26 dated 24/11/22), of Government medical college , Amritsar. Instruments used in study for various measurements include scalpel, scissor, stainless steel forceps, long and short toothed forceps, measuring scale, cotton thread, vernier calliper. Colours are used to highlight different part of extrahepatic biliary apparatus. Red is used for cystic artery, dark green are for gall bladder and cystic duct, light green for common bile duct, blue colour used for portal vein.

Journal of Rare Cardiovascular Diseases
ISSN: 2299-3711 (Print) | e-ISSN: 2300-5505 (Online)
www.jrcd.eu

RESEARCH ARTICLE

RESULTS

In present study on extrahepatic biliary apparatus, Phrygian cap was observed in 2 specimens (4%) out of 50 specimens (fig 1&2). It's a morphological variation of gall bladder. Multiple cystic ducts were observed in 3 (6%) of specimens (fig 5). Gall stones were observed in 7 out of 50 specimens (fig 4). Parallel union of cystic duct with common hepatic duct was seen in 4% of specimens (fig 6). In these specimens cystic duct ran parallel to common hepatic duct for variable distance before these unite with each other . Rest 48 specimens were showing acute union of cystic duct with common bile duct. In present study 2 specimens (4%) were having accessary hepatic duct (fig 3 & 7). Other observations on morphological and morphometric study of extrahepatic biliary apparatus were normal (fig 8). Boundaries of calot's triangle were found to be normal in all specimens with single lymph node and cystic artery crossing it (fig 9)

Figure 1 Gall Bladder with Phrygian's cap

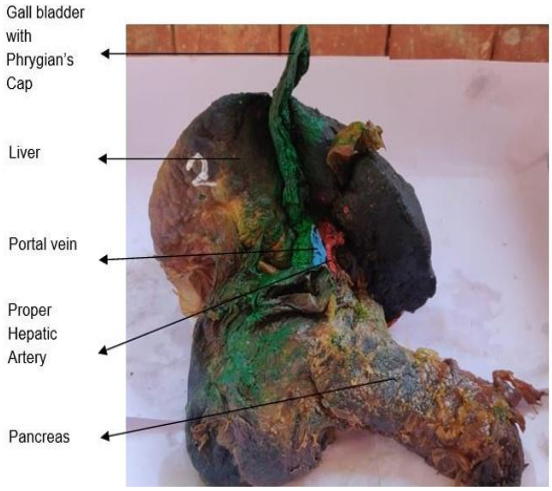

Figure 2 Gall bladder with phrygian's cap side view

Figure 3 Accessary hepatic duct, Common hepatic duct, Cystic duct, Cystic artery and Portal vein

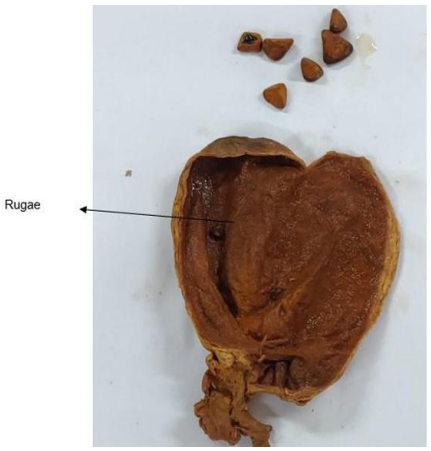

Figure 4 Gall bladder with stones

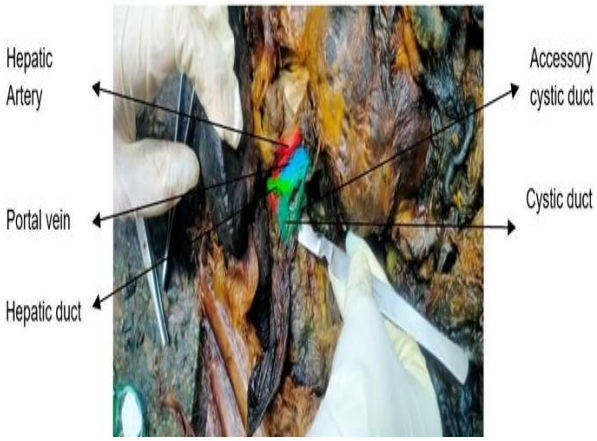

Figure 5 Multiple cystic ducts

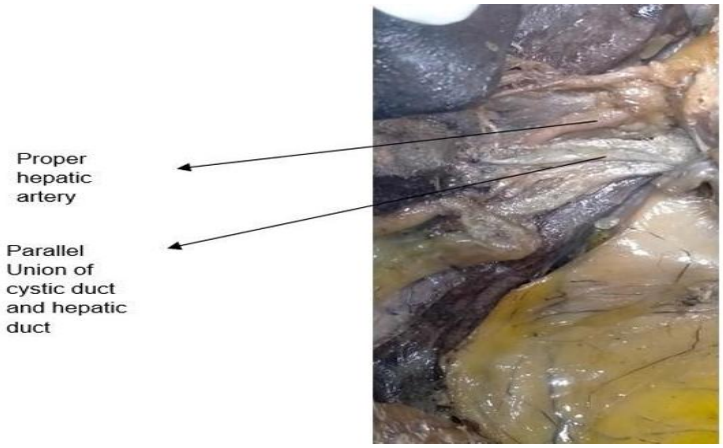

Figure 6 Parallel union of Common Hepatic Duct with Cystic Duct

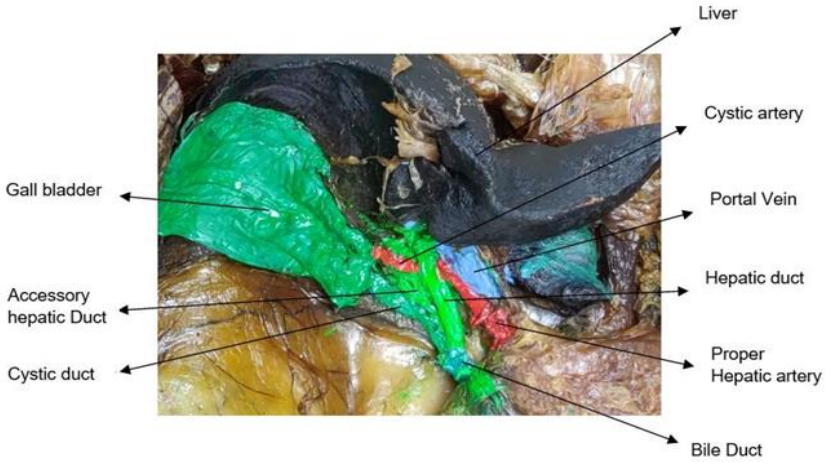

Figure 7 Relations of Accessary Hepatic Duct with cystic artery and portal vein

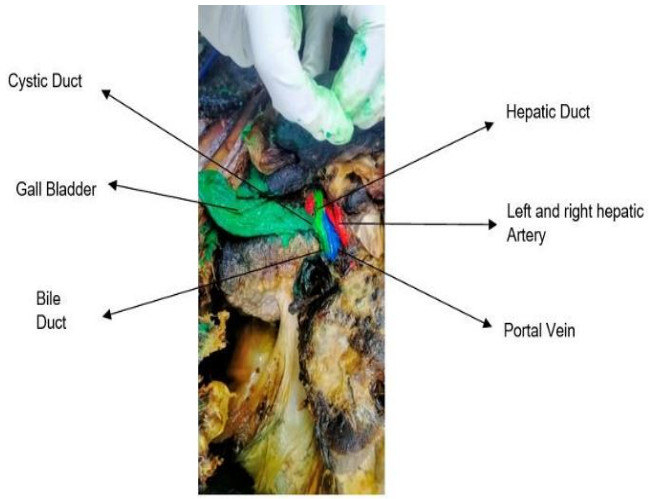

Figure 8 Normal Extrahepatic Biliary Apparatus

Figure 9 Boundaries of Calot's triangle with cystic artery

DISCUSSION

In present study single pear shaped gall bladder was observed in 48 specimens and Phrygian cap was seen in 2 specimens. Gall stones were observed in 7 out of 50 specimens in present study. The observations of present study were in consonance with studies done by Shivanal U et al[5] who observed pear shaped gall bladder in 26 specimens, Phrygian cap or folded fundus and hartman's pouch was observed in 2 out of 50 specimens and Anandhi PG[2] author observed gall stones in 2 (4%) specimens. Das S et al[6] reported multiple stones in 78.33% of specimens and single stone in 21.66% of specimens which was also in consonance with present study observations.

CYSTIC DUCT

In present study single cystic duct was observed in 47 (94%) specimens and multiple in 3% specimens which was in consonance with previous studies done by various authors. Schanhner A[7] in his study he observed 2 cases (2.6%)with double cystic duct out of 76 specimens while Sundaravadhanam KVK[8] et al observed a single specimen with double cystic duct out of 30 cadavers. Parmar P et al[9] observed an accessary cystic duct in 2 (4%) out of 50 specimens.

CYSTIC DUCT UNION WITH COMMON HEPATIC DUCT

In present study acute union observed in 48 specimens. In 2% of specimens cystic duct ran parallel to the common hepatic duct for a variable distance before unite with it. Following table shows the comparison of union of cystic duct with common hepatic duct with previous studies.

Table 1 Comparison of union of cystic duct with common hepatic duct with previous studies

Authors	Acute type union	Parallel type union
Johnson EV et al[10]	51%	31.4%
Thomson JM[11]	90%	6%
Eisendneth[12]	75%	17%
Ruge E[13]	35%	20%
Anupama D et al[14]	86%	2%
Present study	96%	4%

COMMON HEPATIC DUCT

Single normal common hepatic duct was observed in 49% specimens. Only in one specimen accessary hepatic duct was seen, which was present posterior to cystic artery. Cystic artery was present posterior to common hepatic duct and anterior to accessary common hepatic duct. Dowdy et al[15] studied 100 cases to examine the anatomy of liver and bile duct and he discovered accessary hepatic duct in 15% of cases. Sabeersha S[16] studied 55 specimens out of these she noted 7 cases with accessary hepatic ducts. Anupama et al[14] demonstrated 2 cases (4%)of accessary hepatic ducts in which one right hepatic duct drains into confluence and other into common hepatic duct. These previous studies observations were in consonance with present study. In present morphological and morphometric study of extrahepatic biliary apparatus other parameters were also observed which were found normal. Boundaries of calot's triangle were found to be normal in all specimens with single lymph node and cystic artery crossing it.

BIBLIOGRAPHY

1. Standring S. Gray's Anatomy. The anatomical basis of clinical practice. In gall bladder and biliary tree. 40th edition, Ch 69. Elsevier Churchill Livingstone Philadelphia, London. 2008: 1177-81.
2. Anandhi PG and Alagavenkatesan VN. Anatomical variation in extrahepatic biliary system: A cross sectional study. Int J of Res in Med Sci.2018 April, 6(4): 1342-47.
3. Conceica DDCS, Goncalves GR, Seabora JE, Oliveiza et al. Morphometric study of extrahepatic biliary pathways. Study in human corpses. Int J Morphol.2022, 40(1):1342-47.
4. Stringer MD. Gall bladder and extrahepatic bile ducts. In : Tubbs RS, Shoza MM, Mario L eds. Bergman's Comprehensive Encyclopedia of human Anatomical variations. Wiley-Blackwell.2016:1261-71.
5. Shivanal U, Parashuram R, Dakshayani KR. Morphological study of adult human gall bladder in a ,
6. Das S, Nigam A, Singh R. Study of Anatomical variations of extrahepatic biliary system found during cholecystectomy. IJSR.2019;10(2):1036-39.
7. Schachner A. Anomalies of the Gall bladder and bile passages. Ann Surg 1916,64:419-33.
8. Sundravadhanam KVK, Duraipandian K, Radha KT, Anbumani L. Prevalence of anatomical variations of cystic duct among south indian population- A cadaveric study. Med Pul Int J of Anat.2018;7(3):28-30.
9. Parmar P, Rathu SK,Dhattarwal SK, Marwah S. Biliary ductal variations and its clinical implications: A cadaveric study. Int J Res Med Sci. 2017;5:3701-5.
10. Johnston EV, Anson BJ. Variations in the formation and vascular relationship of the bile duct. Surg gynaecol obstat. 1952;94(6):669-86.
11. Thompson JM. Arteries in hepatic pedicle, study in statistical human anatomy . University of California pub anatomy. 1933: 159-555.
12. Eisendrath. Surg, obst, gynea operative injury to common hepatic and bile duct. Surg, obst, gynea 1920;31:1-18.
13. Ruge E. Anomalies of bile duct. Arch F kiln Chi.1908;47:77-78.
14. Anupama D, Shivalula C, R Lakshamiprabha, Subhash A. A study of Anatomy of extrahepatic ducts and its variations with clinical significance. Int J of Anat Res 2016; 4(1):2029-33.
15. Dowdy GS, Waldron GW, Brown WG. Surgical anatomy of panncreaticobiliary ductal system. Observations. Arch Surg 1962;84:229-246.
16. Sabeersha S. A cadaveric study on variations of common hepatic duct. Ind J of Appl Res. 2021;11(6):19-21.