

Case Study

Double Cystic Ducts With The Single Gallbladder

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ABSTRACT

Background: Cystic duct is forming one of the boundaries of triangle of cholecystectomy. The variations in cystic duct anatomy are of considerable importance during surgical excision of the gallbladder. A double cystic duct is very rare and poses a challenge for surgeons during cholecystectomy operation. If duplication of cystic ducts is present, it is associated with a double gallbladder 80% of the time. Presence of duplication of cystic duct associated with a single gallbladder is an extremely rare variant. Most of the times this variation is not picked up on routine preoperative investigations of patients planned for a laparoscopic cholecystectomy and often present as an unusual 'surprise' during surgery and creates a challenge to the surgeons. If they fail to identify this very rare variation they may create iatrogenic injury to these cystic ducts, which leads to bile leakage and other complications.

Aim of the study: To find out the incidence of variations in the number of cystic duct in cadavers.

Materials and Methods: Present study was done in 50 adult cadavers in the Department of Anatomy, Government Tiruvannamalai medical college, Tamil nadu. Meticulous dissection was done in the hepatobiliary system of these cadavers, and the variations in the number of cystic duct were noted.

Observations: Presence of double cystic ducts were seen in three cadavers.

Conclusion: If an anomaly of the biliary ductal system is not identified before or during surgery, it may turn out to be a bile duct injury which leads to bile leak. Hence Surgeons should keep in mind about the possibility of this rare variant double cystic ducts with a single gallbladder while performing cholecystectomy surgery.

KEY WORDS: Cystic duct, Gallbladder, Cholecystectomy.

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Access this Article online	Journal Information
Quick Response code 	International Journal of Anatomy and Research ISSN (E) 2321-4287 ISSN (P) 2321-8967 https://www.ijmhr.org/ijar.htm DOI-Prefix: https://dx.doi.org/10.16965/ijar
	
	Article Information
	Received: 13 Jan 2022 Peer Review: 14 Jan 2022
	Accepted: 03 Mar 2022 Published (O): 05 Jun 2022 Published (P): 05 Jun 2022
DOI: 10.16965/ijar.2022.111	

INTRODUCTION

Laparoscopic cholecystectomy (LC) has become standard surgical treatment for gallstone disease [1]. Laparoscopic cholecystectomy may reduce the duration of hospital admission and improve some intra-operative and postoperative outcomes compared with open cholecystectomy, but it may increase the risk of bile duct injury [2]. Congenital malformations of the gallbladder (GB) and cystic duct (CD) are rare but important entities that might remain asymptomatic throughout life. However, these

anomalies demand greater attention during surgery, much more so when the procedure is laparoscopically performed [3]. The limited success of preoperative biliary tract imaging in demonstrating anatomic aberrancies prior to cholecystectomy clearly highlights the importance of maintaining constant vigilance for even the slightest anatomic abnormality at operation [4]. There is a wide range (0.5% to 1.5%) of incidence of bile duct Injury duringL aparoscopic cholecystectomy (LC) compared

to 0.3% for open cholecystectomy (OC) [1]. Up to one quarter of people having laparoscopic cholecystectomy may need conversion to open surgery because of risks of complications or uncontrolled bleeding [2]. Success of preoperative biliary tract imaging in demonstrating anatomic aberrancies prior to cholecystectomy clearly highlights the importance of maintaining constant vigilance for even the slightest anatomic abnormality at operation [4]. There is a wide range (0.5% to 1.5%) of incidence of bile duct injury during laparoscopic cholecystectomy (LC) compared to 0.3% for open cholecystectomy (OC) [1]. Up to one quarter of people having laparoscopic cholecystectomy may need conversion to open surgery because of risks of complications or uncontrolled bleeding [2].

The extrahepatic biliary system displays the highest number of anatomical variations of any site in the body [5].

Due to complex embryological development, 10% of the biliary collecting systems have anatomical variations. Congenital abnormalities of extrahepatic biliary duct system are possibly the most frequent variations of the human body [6]. In 1981, Rocko and DiGioia described a triangular area bounded medially by hepatic duct, laterally by the cystic duct, and superiorly by the under surface of the liver and they named it as "triangle of cholecystectomy". Usually, the Cystic artery runs across this triangle from left to right for reaching the gallbladder. In this triangle cystic artery is positioned between the Cystic duct below and the under surface of the liver above [7]. As cystic duct is forming one of the boundaries of this very important triangle, any variation of cystic duct may have an impact in outcome of cholecystectomy surgery. So surgeons should have a better knowledge about possible variations of cystic duct before doing cholecystectomy surgery to avoid complications.

Normal anatomy of cystic duct and its duplication variation: Cystic duct drains the gallbladder into the common bile duct. This cystic duct will be single in number, and it passes posteriorly to the left from the neck of gallbladder, and joins the common hepatic duct to form the common bile duct. It is the

usual pattern of anatomy of cystic duct in most of the cases.

But cystic duct may have several important variations in its anatomy. The cystic duct occasionally drains into right hepatic duct. Rarely, the cystic duct is double or even absent [8]. These variations in cystic duct anatomy are of considerable importance during surgical excision of the gallbladder. Ligation or clip occlusion of the cystic duct must be performed at an adequate distance from the common bile duct to prevent angulation or damage to it [8]. Accessory ducts must not be confused with the right hepatic or common hepatic ducts [8]. A double cystic duct is very rare and poses a challenge for surgeons during an operation. Diagnosis of this condition is usually confirmed during laparoscopic cholecystectomy [9]. Double cystic ducts are associated with a double gallbladder 80% of the time [10]. Presence of duplication of cystic duct associated with a single gallbladder is an extremely rare variant [4,10]. The intraoperative detection of cystic duct anomalies and more specifically, a duplicated cystic duct insofar as it is an aberrant type, is a daunting challenge to surgeons. Postoperative bile leakage is a serious complication. Other possible complications include conversion into open surgery, bile fistulae, and liver cyst infection [11].

The diagnosis of double cystic ducts is usually established during surgery. However, sometimes it may be missed intraoperatively and diagnosed postoperatively during a diagnostic work up performed for persistent biliary symptoms. Preoperative diagnosis is difficult due to rarity of the variation and difficulty in visualization of the two ducts by radiological imaging [12]. When comparing with the males, duplicated cystic ducts are common among females [11]. Females constituted 75% of the reported cases [4].

Developmental anatomy of cystic duct: The liver, gallbladder, and biliary ductal system arise as a ventral outgrowth (the hepatic diverticulum) from the distal part of the foregut early in the fourth week of intrauterine life. Wnt/ β -catenin signalling is involved in the induction of the hepatic diverticulum [13].

In a normal human embryo, this hepatic diverticulum starts to divide into a cranial bud and a caudal bud during the 6th week. The cranial bud or pars hepatica, further gives rise to the liver with its intrahepatic biliary ducts, while the caudal bud or pars cystica, further gives rise to the extrahepatic biliary ducts, including the gallbladder, the cystic duct and the common bile duct. Early division (5th week) of the pars cystica results in two complete gallbladders and two cystic ducts [14]. So this article mentions about the embryological basis for double cystic ducts with double gallbladders. But I could not find any article explaining about the embryological basis for double cystic ducts with a single gallbladder even after my extensive search.

MATERIALS AND METHODS

Present study was conducted in 50 adult cadavers in the Department of Anatomy, Government Tiruvannamalai Medical College, Tiruvannamalai, Tamilnadu. The dissection was done in the conventional method as given in the Cunninghams manual of practical anatomy. The abdomen was dissected , and the cystic duct and other ducts of extrahepatic biliary apparatus were traced. The variations in the number of cystic duct were noted.S

OBSERVATIONS

Present study was conducted in 50 adult cadavers, and the number of cystic duct in each cadaver was noted. Single cystic duct was present in 47 cadavers (94 %). Double cystic ducts were seen in 3 cadavers (6%). Other variations like absence of cystic duct and Triple cystic ducts were not found in my present study.

Among these three cadavers having double cystic ducts, “Y” type pattern of double cystic ducts were present in 2 cadavers (4%) in which two cystic ducts join in a “Y” shaped manner to form a common duct, and then this common duct joins with the common hepatic duct to form common bile duct [figure 1 & figure 2], “H” type insertion of double cystic ducts was seen in one cadaver (2%) in which both cystic ducts open separately into right hepatic duct [figure 3] . But “Trabecular” type of insertion (one cystic duct enters the

Common bile duct while the other cystic duct directly enters into the liver parenchyma) was not seen in my present study.

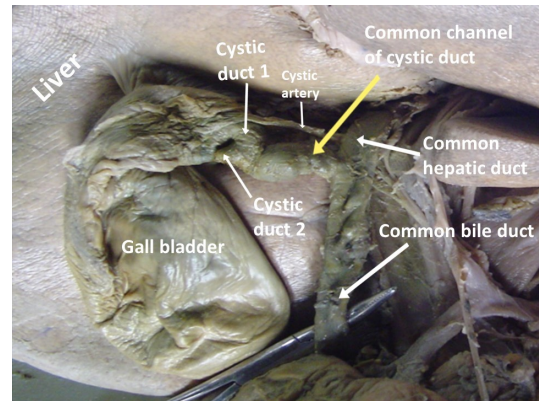


Fig. 1: (1st case of “Y” shaped Double cystic ducts): Two cystic ducts (cystic duct 1 & cystic duct 2) arise from a single gallbladder, then these two cystic ducts join in a “Y” shaped manner to form a common channel of cystic duct, which joins with the common hepatic duct for forming common bile duct.

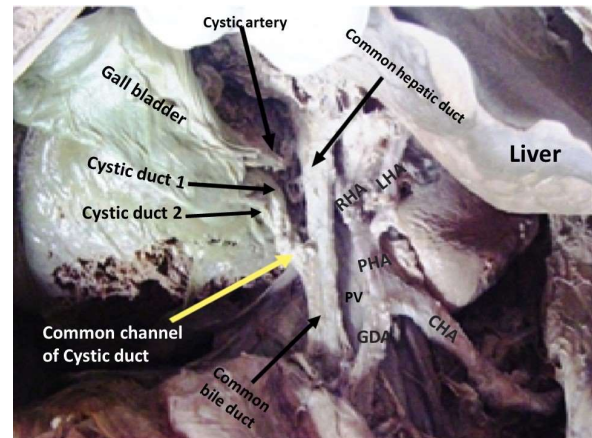


Fig. 2: (Second case of “Y” shaped Double cystic ducts): Two cystic ducts (cystic duct 1 & cystic duct 2) arise from a single gallbladder, then these two cystic ducts join in a “Y” shaped manner to form a common channel of cystic duct, which joins with the common hepatic duct for forming common bile duct.

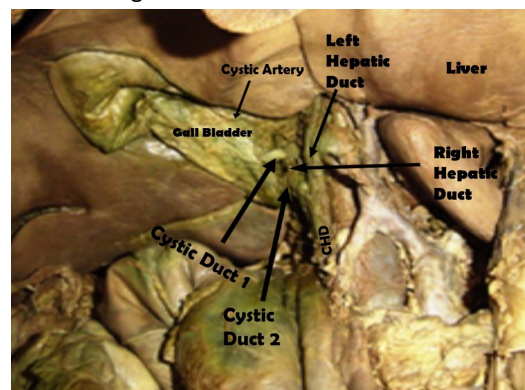


Fig. 3: (“H” shaped insertion of Double cystic ducts): Two cystic ducts (cystic duct 1 & cystic duct 2) arise from a single gallbladder , then these two cystic ducts running independently parallel to each other for draining into right hepatic duct separately in a “H” shaped pattern.

Table 1: Numbers of Cystic duct.

S.No	Numbers of Cystic duct	Incidence	Incidence
		(in Number of Cadavers)	(in Percentage)
1	Single Cystic Duct	47	94%
2	Double Cystic Duct	3	6%
3	Triple Cystic Duct	0	0%
4	Absence of Cystic Duct	0	0%

Table 2: Different Types of insertion of Double Cystic Ducts.

S.No	Types of Double Cystic Ducts (Depending upon the mode of insertion of two cystic ducts)	Incidence	Incidence
		(in Number of Cadavers)	(in Percentage)
1	“Y” shaped insertion	2	4%
2	“H” type insertion	1	2%
3	“Trabecular “ type insertion	0	0%

DISCUSSION

Anomalies are the rule, not the exception. As with any procedure, the knowledge of normal anatomy and common variants is critical to the success of surgical intervention [15]. The anatomy of the biliary tree is complex, and its variations of both intra and extra hepatic bile ducts can be found in approximately 30% of the general population. These variations are not picked up on routine pre-operative investigations of patients planned for a laparoscopic cholecystectomy (LC) and often present as an unusual ‘surprise’ and a challenge that can make dissection in the Calot’s triangle difficult leading to iatrogenic injury [16]. The preoperative identification of such anomalies is important for avoiding complications. Preoperative diagnosis might be difficult. This high rate of intraoperative diagnosis might be due to the magnified visual effects of laparoscopic surgery and fine dissection [17].

Double cystic ducts may be connected to two different gallbladders separately or may be connected to a single common gallbladder. The two cystic ducts draining into two distinct gallbladders separately was seen as a more common type, and this type was reported by many authors in various articles. But the other type is extraordinarily rare in which duplicated cystic ducts are draining into a single gallbladder. This rare type was reported in fewer than 20 cases in English literatures from 1961 to 2019[4]. In my present study I found three

cadavers having double cystic ducts with a single gallbladder only. I did not find double gallbladders in any cadavers of my present study.

In 1956, Caster and Flannery studied 101 cases with the congenital abnormalities of the gallbladder and categorized double cystic ducts into three types according to the site of the drainage. Caster and Flannery categorized cystic duct duplication into 3 types: (1) “Y” type, wherein 2 cystic ducts join to form a single cystic duct that then enters the CBD, (2) “H” type, in which each cystic duct independently joins the bile duct system at the CBD, right hepatic duct, left hepatic duct or common hepatic duct, and (3) trabecular type, in which one cystic duct enters the CBD while the other directly enters the liver parenchyma [18]. The first type (“Y” type) of double cystic ducts was observed in two cadavers (4%) of my present study. The second type (“H” type) of double cystic ducts was seen in one cadaver (2 %) of the present study, in which both cystic ducts open separately into right hepatic duct. The third type (“Trabecular” type) of double cystic ducts was not seen in my present study.

Y type variant of double cystic ducts was seen in a case of Samnani et al study [19] and in a case of Salih AM et al study [12] also. As I already mentioned, “Y” type of double cystic ducts were seen in two cadavers (4%) of my present study.

According to Munie et al study [4] and other

English literatures from 1961 to 2019, “H” type variation was the commonest type seen in their studies. But in my present study “Y” type variation is the common type seen in two cadavers (4%), and the “H” type variation is seen in only one cadaver (2%) of the present study.

A case of a double cystic duct originating from a single gall bladder drained by separate opening to common hepatic duct was seen in Abdelsalam AM et al study [10]. This type of variation was not seen in my present study.

In Hirono et al study [20], a rare variant was found. It has a single gallbladder with two cystic ducts, in which one cystic duct joined the common hepatic duct and the other cystic duct joined into the right hepatic duct. This rare variant is not found in my present study.

In Angsuwatcharakon et al study [21] they found a case of congenital absence of cystic duct. But this variant was not present in any cadaver in my study. Single gallbladder with triple cystic ducts was not reported by any articles till now. Triple cystic ducts were not found in my study also.

CONCLUSION

In conclusion, double cystic ducts is a very rare variant of the cystic duct. Identification of this variation preoperatively or intraoperatively is very important. Otherwise it may turn out to be a bile duct injury which leads to bile leak. Hence Surgeons should keep in mind about the possibility of this very rare variant double cystic ducts with a single gallbladder while performing cholecystectomy surgery.

ABBREVIATIONS

GB - Gall bladder **CD** - Cystic duct
CHD - Common Hepatic Duct
CBD - Common Bile Duct
RHA - Right hepatic artery
LHA - Left hepatic artery
PHA - Proper hepatic artery
CHA - Common hepatic artery
GDA - Gastro duodenal artery
PV - Portal vein **OC** - Open Cholecystectomy
LC - Laparoscopic Cholecystectomy

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Conflicts of Interests: None

REFERENCES

- [1]. Sharma S, Behari A, Shukla R, Dasari M, Kapoor VK. Bile duct injury during laparoscopic cholecystectomy: An Indian e-survey. *Ann Hepatobiliary Pancreat Surg.* 2020;24(4):469-476.
- [2]. Halpin V. Acute cholecystitis. *BMJ Clin Evid.* 2014 Aug 20;2014:0411.
- [3]. Pavlidis TE, Triantafyllou A, Psarras K, Marakis GN, Sakantamis AK. Long, parallel cystic duct in laparoscopic cholecystectomy for acute cholecystitis: the role of magnetic resonance cholangiopancreatography. *JSLS.* 2008 Oct-Dec;12(4):407-9.
- [4]. Munie S, Nasser H, Go PH, Rosso K, Woodward A. Case report of a duplicated cystic duct: A unique challenge for the laparoscopic surgeon. *Int J Surg Case Rep.* 2019;56:78-81.
- [5]. M. A. Hayes, I. S. Goldenberg and C. C. Bishop, “The Developmental Basis for Bile Duct Anomalies,” *Surgery, Gynecology & Obstetrics*, 1958;107(4):447-456.
- [6]. Senapati A, Wolfe JH. Accessory cystic duct—an operative hazard. *J R Soc Med.* 1984 Oct;77(10):845-6.
- [7]. Kumar S, Joshi MK. Calot’s Triangle: Proposal to Rename it as Calot’s Region and the Concept of ‘Ducto-Arterial Plane’. *Indian J Surg.* 2015 Dec;77(Suppl 3):899-901.
- [8]. Gray’s anatomy, Anatomical basis of clinical practice, 40th edition, 2008; p.1178.
- [9]. Bernard P, Letessier E, Denimal F, Le Neel JC. Accessory cystic duct discovered by intraoperative cholangiography during cholecystectomy. *Ann Chir.* 2001 Dec;126(10):1020-2.
- [10]. Abdelsalam AM, Elansary AMSE, Mostafa Ibrahim Mohamed A. A case report of double cystic duct during laparoscopic cholecystectomy in patient with chronic calculous cholecystitis. *Int J Surg Case Rep.* 2021 Jan;78:116-119.
- [11]. Anisi H, Vahedian Ardakani J, Khoonsari M, Chavoshi Khamneh A. A Double Cystic Duct With a Single Gallbladder Successfully Treated With Laparoscopic Cholecystectomy: A Challenge to Laparoscopic Surgeons. *Iran J Med Sci.* 2020 Sep;45(5):391-394.
- [12]. Salih AM, Kakamad FH, Mohammed SH, Salih RQ, Habibullah IJ, Muhiudeen AS, Fatih H. Double cystic duct, a review of literature with report of a new case. *Int J Surg Case Rep.* 2017;38:146-148.
- [13]. KLM Developing Human Clinically Oriented Embryology 10th Edition 2016.
- [14]. A systematic review of the anatomical findings of multiple gallbladders. *International Hepato-Pancreato-Biliary Association (HPB)* 2018;20(11):985-991.

- [15]. Maingot's Abdominal operations, 12th edition, 2013: pp.993-994.
- [16]. Rodrigues G, Pandit SR, Khan A, Veerabharappa B, Jayasankar B, Anaparti R. High insertion of cystic duct at the gallbladder fundus: An undescribed anomaly! J Minim Access Surg. 2019 Jul-Sep;15(3):256-258.
- [17]. Fujii A, Hiraki M, Egawa N, Kono H, Ide T, Nojiri J, Ueda J, Irie H, Noshiro H. Double cystic duct preoperatively diagnosed and successfully treated with laparoscopic cholecystectomy: A case report. Int J Surg Case Rep. 2017;37:102-105.
- [18]. Caster M.P., Flannery M.G. Congenital abnormalities of the gallbladder; 101 cases. Surg. Gynecol.Obstet. 1956;103:439-457.
- [19]. Samnani SS, Ali A. "Y" Variant of Double Cystic Duct: Incidental Finding During laparoscopic Cholecystectomy. Indian J Surg. 2015 Dec;77(Suppl 3):1491.
- [20]. Hirono Y, Takita Y, Nitta N, Hashimoto H. Double cystic duct found by intraoperative cholangiography in laparoscopic cholecystectomy. Surg Laparosc Endosc. 1997 Jun;7(3):263-5.
- [21]. Angsuwatcharakon P, Piyachaturawat P, Pantongrag-Brown L, Rerknimitr R. Cholangioscopy to diagnose and treat a patient with congenital absence of the cystic duct. Gastrointest Endosc. 2021 Oct 12:S0016-5107(21)01722-3.

How to cite this article:

K.Sangameswaran. Double Cystic Ducts With The Single Gallbladder. Int J Anat Res 2022;10(2):8331-8336. DOI: 10.16965/ijar.2022.111