

## A STUDY OF GALL BLADDER, CYSTIC AND HEPATIC DUCTS IN NORMAL ADULTS

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### Abstract

**Background:** The extrahepatic biliary tree is vital and the gallbladder has been an organ of speculation since ancient times. The gallbladder plays an important role in bile salt metabolism and fat digestion. It is the site of various disorders, making it important for doctors, residents, and surgeons to have adequate knowledge of its normal and variant anatomies. The aim is to study the normal and variant anatomy of the extrahepatic biliary system in the South Indian population. **Materials and Methods:** This study included 50 cadaveric specimens obtained from the Institute of Anatomy and Department of Forensic Medicine, Madurai Medical College. The gallbladder, cystic artery, cystic duct, and hepatic duct were dissected and examined. **Result:** The results showed that the gallbladder was single and positioned extrahepatically in all specimens, with a normal shape in 96%. The cystic duct was observed to terminate at an acute angle on the right side of the common hepatic duct in 49 specimens. The common hepatic duct was formed by union of the right and left hepatic ducts, and its length ranged from 2.0 to 2.2 cm. The cystic artery was observed to be the content of Calot's triangle in all the specimens, with the source being the right hepatic artery. **Conclusion:** Variations in the extrahepatic biliary system were minimal in the South Indian population compared with earlier reports. This study provides valuable information to surgeons in this region.

## INTRODUCTION

Although the extrahepatic biliary tree is vital, it is not indispensable for life.<sup>[1]</sup> The gallbladder has been an organ of speculation since ancient times.<sup>[2]</sup> According to Jacopo da Carpi (1522), "Sometimes a man lacks a gallbladder; he is then of infirm health and shorter life".<sup>[3]</sup> The gallbladder plays an important role in the metabolism of bile salts and subsequently that of fat. The gallbladder is the site of various congenital, metabolic, endocrine, obstructive, inflammatory, and malignant disorders.<sup>[4]</sup> Hence, the importance of this organ must be stressed again. Thus, this organ is important for a doctor in the outpatient department, a resident in the emergency room, and a surgeon on the operating table.<sup>[1,4]</sup> "It can be safely stated that 15% of the people of the United States suffer from biliary disease, and that this figure is increased to 30% after 45 years of age".<sup>[5]</sup> In addition, 80 per cent of all operations performed on the gallbladder and bile passages are for gallstones or complications produced by gallstones.<sup>[6]</sup>

The recent increase in the rate of cholecystectomies performed, particularly laparoscopic procedures, has made it imperative for surgeons to have adequate knowledge of the normal and variant anatomy of the

extrahepatic biliary system, and this was the key to this study.

### Aim

To study the normal and variant anatomy of the extrahepatic biliary system in a South Indian population.

## MATERIALS AND METHODS

This study was conducted on 50 specimens obtained from cadavers of the Institute of Anatomy, Madurai Medical College, and the Department of Forensic Medicine, Madurai Medical College. The study was approved by the institutional ethics committee before initiation, and informed consent was obtained from all patients.

### Exclusion criteria

The abdominal cavity was opened using a cruciate incision, and the vertical component extended from the xiphoid process to the pubic symphysis, encircling the umbilicus, with a horizontal incision just below the umbilicus.

The liver and stomach were exposed and the lesser omentum was identified. The right free margin of the lesser omentum was dissected and the hepatic ducts, hepatic artery, and portal vein were exposed. The lower end of the oesophagus and pyloric end of the

stomach were ligated and cut, and the stomach was removed. The liver was mobilised by incising the peritoneal folds. The hepatic part of the inferior vena cava was cut, and the liver was removed from the body using the gall bladder and cystic and hepatic ducts.

Specimens collected from the Department of Forensic Medicine were removed post-mortem. A vertical incision was made from the root of the neck to the pubic symphysis, exposing the thoracic and abdominal cavities. The anterior abdominal wall of the umbilicus was retracted on both sides and the abdominal organs were exposed. The stomach was removed after cutting the oesophageal and pyloric ends. The liver was mobilised by incising the peritoneal folds and inferior vena cava and removing it from the gallbladder. The gall bladder, cystic artery, cystic duct, and right, left, and common hepatic ducts were dissected from all specimens. All the data are presented as frequencies.

## RESULTS

The gall bladder number in the 50 specimens was single, the position in the 50 specimens was normal, the situation in the 50 specimens was extrahepatic, and the mesentery in the 50 specimens was absent. The shape of the gall bladder studied in 50 specimens was normal in 48 specimens (96%). Hartman's pouch was observed in two specimens (4%).

The mucosa was normal in 49 of the specimens. The mucosa was removed from each specimen. Gall stones were observed in the same specimen. This was also associated with the presence of the Hartman's pouch. No septum or diverticulum was found in any specimen in the present study. The length of the gall bladder ranged from 6 to 8 cm, with an average of 6.47 cm. The standard deviation was 0.45 and the standard error was 0.06. A length of 6.5 cm was observed at the maximum frequency.

The maximum width varied from 3 to 4 cm in the gall bladders studied. The average maximum width was 3.14, with a standard deviation of 0.25 and a standard error of 0.03. A width of 3 cm was observed to have the highest incidence rate. The width of the middle gall bladder ranged from 2 to 3 cm, with an average of 2.21 cm. The standard deviation 0.25 and the standard error was 0.03.

The maximum frequency of the distance from the fundus to the inferior border of the liver was 1.1 cm. The length of the cystic duct was measured from the neck of the gallbladder to the part joining the common hepatic duct. The length of the cystic duct with maximum frequency was 2.2 cm. The mean length of the cystic duct length was 2.17. The standard deviation was 0.09 and the standard error was 0.01.

Typically, the cystic duct terminates at an acute angle on the right side of the common hepatic duct. This was observed in 49 of the specimens. In one specimen with two cystic ducts, one cystic duct terminated normally and the second cystic duct opened independently into the duodenum. The common hepatic duct is formed close to the right end of the porta hepatis by union of the right and left hepatic ducts (Datta, 2000). The length of the common hepatic duct ranged from 2.0 cm to 2.2 cm. The maximum frequency was observed at 2.2 cm.

The relationship between the common hepatic duct and the portal vein and common hepatic artery was normal in all 50 specimens. The cystic artery was observed to be the content of Calot's triangle in all the 50 specimens studied. In one specimen, a small nodular mass, <1 mm in size, was observed. The source of the cystic artery in the 50 specimens studied was the right hepatic artery [Table 1].

The fundus and body were normal in all 50 specimens studied. The neck revealed Hartman's pouch in 2 specimens and was normal in the rest of the specimens [Table 2].

**Table 1: Demographic data of the study.**

		Frequency
Gall bladder number	Single	50
	Absence	-
	More than one	-
Gall bladder position	Inferior surface of the right lobe of the liver	50
	Others	-
Situation of the gallbladder	Extrahepatic in the fossa for gall bladder in the right lobe of the liver	50
	Intrahepatic partial complete	-
	Partially intrahepatic	-
	Left lobe of the liver	-
Mesentery of the gallbladder	Present	-
	Absent	50
Gall bladder shape	Pear shaped	48
	Phrygian cap	-
	Bilobed	-
	Hartman's pouch	-
	Hour glass	-
Interior of the gallbladder	Normal	49
	Ironed out	1
	Gall stones	1
	Diverticulum	Nil
	Spectrum	Nil
Length in centimetres	6	17

	6.5	23
	7	7
	7.5	2
	8	1
Maximum width	3	37
	3.5	12
	4	1
Width in the middle	2	30
	2.5	19
	3	1
Distance of fundus from the inferior border of the liver in centimetres	1	6
	1.1	17
	1.2	13
	1.3	10
	1.4	3
	1.5	1
Cystic dust number	1	48
	2	2
Cystic dust length	2.4	3
	2.3	7
	2.2	19
	2.1	18
	2	3
Most of the termination of the cystic dust	Normal	49
	Others	1
Common hepatic duct length	2	2
	2.1	20
	2.2	21
	2.3	7
Relations of the common hepatic duct	Normal	50
	Others	0
Content of calot's triangle	Normal	50
	Others	0
Cystic artery organ	Right hepatic	50
	Others	0

**Table 2: Part of gall bladder**

		Frequency	
		Normal	Others
Part of gall bladder studied	Fundus	50	-
	Body	50	-
	Neck	48	Hartman's pouch 2

## DISCUSSION

Various cases reported over time include double gallbladders sharing a common septum but with separate cystic ducts (Meyer et al., 1949), widely separated gallbladders except at their necks (Guyton, 1946), and an accessory gallbladder without a cystic duct (Gross, 1936). Holmes (1916) described a patient with gallbladders reduced to small vesicles with an atretic cystic duct, a type similar to that described by Morgagni (1769). Skielboe (1958) reported a triple gallbladder case with each duct entering the common duct separately.<sup>[8-10]</sup>

Reports on the frequency of congenital absence of the gallbladder vary: Tallmadge (1938) estimated 0.065%, Mouzas and Wilson (1953) estimated 0.042%, Monroe (1959) estimated 0.013%, and McHrath and colleagues (1962) estimated 0.04%. Other studies have reported absence rates of 0.065% (Latimer, 1947), 0.3% (Mendez, 1947), and 0.075% (Hage, 1947). Bower (1928) described an extreme case of absence of the gallbladder, cystic and common ducts, and the left lobe of the liver. Frey et al. (1967) confirmed 56 cases of congenital

gallbladder absence. Theodor (1908) and Dixon and Lichtmann (1945) reported the absence of both the pancreatic head and gallbladder. Latimer et al. (1947) noted cases with a part of the cystic duct present without a gallbladder.<sup>[9,11,12]</sup>

The gallbladder is typically located on the inferior surface of the right liver lobe in a depression called the fossa (Hollinshead 1966). In the 50 specimens studied, all gallbladders were single and extrahepatic, and attached to the liver by connective tissue. Mobile gallbladders were reported by Haines and Kane (1946), and the first case of torsion was reported by Morgagni (1769). The gallbladder is normally covered by the peritoneum only on the surface and is not in contact with the liver. Hartmann's pouch, an acquired deformation due to gallbladder emptying resistance, was observed in 4% of specimens.<sup>[13,14]</sup>

Various congenital anomalies have been reported, including the folded fundus (Phrygian Cap) described by Hollinshead (1966), multiseptate gallbladder (Knetsch, 1952), and diverticula, which were acquired by Robertson and Ferguson (1945). Gallstones are found in 10% of all autopsies (Crump, 1931), with Hansen (1927) estimating a frequency of 24.7%, Mentzer (1927) 21.6%, and Robertson (1945)

16.3%.<sup>[15]</sup> In the present study, one specimen (2%) had gallstones.

The cystic duct, typically 3-4 cm in length and 2 mm in diameter, opens into the common hepatic duct at an acute angle (Datta 2000). Perelmann (1961) described a double cystic duct, which was observed in two cases in the present study. The length of the cystic duct varied from 0.4 cm to 6 cm in other studies (Dowdy et al., 1962), within the 2.2-3 cm range observed in this study. The common hepatic duct is approximately 3 cm long and 4 mm in diameter (Datta, 2000).<sup>[16]</sup> No accessory hepatic ducts were observed in the present study, unlike previous findings by Flint (1923) and others.

Calot's triangle, which is important in cholecystectomy, contains the cystic artery in 90% of cases (Mossman 1948). The cystic artery usually arises from the right hepatic artery, which is consistent with the results of the present study. Double cystic arteries were reported in approximately 15% of cases by Thompson (1933) and Daseler et al. (1947), but were not observed in the present study. Michels (1951) reported tripling of cystic arteries in 7 cases.<sup>[17]</sup> Aneurysms of the right hepatic artery were reported by Frank and Ferguson (1956) but not observed here. Flint (1923) and Michels (1949) found anomalous right hepatic arteries in a significant number of dissections, a finding that was not replicated in this study. The common hepatic duct's formation, typically outside the liver (Thompson, 1933), was observed in all specimens.<sup>[18]</sup>

No accessory hepatic ducts were found, unlike previous studies (Dowdy et al. 1962; Michels 1955). Calot's triangle contains structures important for surgery, including the cystic artery and accessory bile ducts (Mossman, 1948). Variations in the cystic artery's origin were noted by Eisen Drath (1918) and Dasseler et al. (1947), with the present study finding the artery always arising from the right hepatic artery.<sup>[19]</sup>

## CONCLUSION

A single extrahepatic gall bladder lodged in the fossa for the gall bladder, covered with peritoneum only on the posterior surface, and rugae in the interior were observed in all cases. The supernumerary gall bladder, intrahepatic gall bladder, left-sided gall bladder, floating gall bladder, diverticula of the gall bladder, Piephygian cap, and septate gallbladder, although occasionally reported earlier, were not observed in the present study. Hartmann's pouch was found in 4% in this study as a variation in the shape. The dimensions of the gallbladder were compared with those in previous reports. The cystic duct was normal in number, length, and termination in 96% of the specimens studied. A double cystic duct was observed in 4% of cases. The termination of one cystic duct in the common hepatic duct and the other in the duodenum was a rare anomaly observed in one specimen studied.

The hepatic ducts in the present study were normal in all the 50 specimens. Although variations were observed in relation to the source, number, and course of the cystic artery in the Calot's triangle, they were found to be normal in this study. The course of the right hepatic artery was posterior to the hepatic duct in 96% and anterior to the duct in 4%, as reported earlier. The study indicates that the variations are minimal in this area in the south Indian population, although many anomalies have been reported earlier. This study is presented to help surgeons in southern India.

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