

The Diameter of the Normal Extrahepatic Bile Duct among Patients Diagnosed with Cholecystolithiasis Managed at the Philippine General Hospital

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ABSTRACT

Background and Objective. Understanding the normal anatomy and size of the extrahepatic biliary tree is vital for surgeons to make informed decisions regarding the necessity of additional procedures beyond cholecystectomy. The extrahepatic bile duct (EHBD) comprises the common hepatic duct (CHD) and the common bile duct (CBD), with the former formed by the convergence of the right and left hepatic ducts and the latter extending from the CHD to the duodenum. A normal diameter is indicative of the absence of any signs of obstruction in the EHBD, and the determination of the average range for these ducts are essential for identifying pathologies that may require further surgical intervention. Cholecystolithiasis is a common condition managed at the Philippine General Hospital (PGH). Trans-abdominal ultrasonography is frequently utilized to diagnose cholecystolithiasis, and it can also be used to determine the size of the common bile duct. Knowledge of the normal CBD diameter aids clinicians in distinguishing obstructed bile ducts from normal ones, prompting further diagnostic tests for improved patient management. However, there is limited data on the average diameter of the CBD among Filipino patients with this condition. The study aimed to determine the mean diameter of the common bile duct and common hepatic duct among patients diagnosed with cholecystolithiasis with no signs of obstruction in the EHBD managed at the Philippine General Hospital.

Methods. This prospective cross-sectional study included 80 patients who underwent cholecystectomy with intraoperative cholangiography. The CBD and CHD diameters were measured using intraoperative ultrasonography, and the data were analyzed using descriptive statistics and independent t-test.

Results. The mean diameter of the CBD was 5.17 mm, with a range of 2.7-10 mm (1.41) mm. The mean diameter of the CHD was 4.71 mm, with a range of 2.3- 10 mm (1.59) mm. There was no significant difference in the CBD and CHD diameters between male and female patients, and across different age groups.

Conclusion. In patients with cholecystolithiasis managed at the PGH, the mean diameter of the CBD and the CHD was 5.17 mm and 4.71 mm, respectively, with no significant difference between genders and age groups. The mean diameter of the CBD among Filipino patients with cholecystolithiasis is similar to those reported in other countries. These findings may have clinical implications for the management of patients with cholecystolithiasis, particularly in the planning of endoscopic retrograde cholangiopancreatography (ERCP) and laparoscopic cholecystectomy. Further studies with larger sample sizes and different populations are recommended to validate these results. These findings can aid clinicians in determining the need for pre-operative Magnetic Resonance Cholangiopancreatography (MRCP) or selective intraoperative cholangiography to detect extrahepatic bile duct obstruction.

Keywords: common bile duct, cholecystolithiasis, Philippine General Hospital

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INTRODUCTION

The extrahepatic bile duct (EHBD), typically measuring around 6 mm in diameter, consists of the upper common hepatic duct (CHD) and the lower common bile duct (CBD). The common hepatic duct is formed by the union of the right and left hepatic ducts, which can join at various angles or run in parallel. The CBD, averaging 8 cm in length and 4 to 9 mm in diameter, is considered enlarged if it exceeds 10 mm.^{1,2}

Measuring the diameter of the extrahepatic bile duct and determining its upper limit have been commonly used to indicate the possibility of a bile duct obstruction. If bile duct dilatation is detected during initial imaging, further investigation is needed. It is crucial to establish the upper normal limits of the extrahepatic bile duct for the Filipino population since there is currently limited data available on its size.

Studies investigating normal extrahepatic biliary duct (EHBD) measurements have utilized a range of measurement methods, including cadaveric measurement, operative cholangiography, Endoscopic Retrograde Cholangiopancreatography (ERCP)/MRCP, computed tomography, and ultrasonography.³ Among these methods, ultrasonography has been shown to be both sensitive and specific, making it a valuable and cost-effective tool for measuring EHBD.

A number of studies have investigated the relationship between CBD size and age/sex⁴⁻⁶, with ultrasonography indicating a gradual increase in CBD size with advancing age among the Indian⁴ and Nepalese⁵ populations. However, there is currently a lack of research on the normal EHBD diameter and its correlation with age and sex among the Filipino population.

This study aims to establish the average diameter range of the extrahepatic biliary duct in a representative sample of the Filipino population who have undergone cholecystectomy for gallstones with no evidence of EHBD obstruction at PGH, and to examine its correlation with age and biological sex.

OBJECTIVES

This study aims to:

1. Determine the average size range of the extrahepatic bile duct in the Filipino population who have undergone Cholecystectomy with Routine Intraoperative Cholangiography (IOC) in the Division of Hepatobiliary and Pancreatic Surgery of the University of the Philippines – Philippine General Hospital (UP-PGH).
2. Determine the correlation between the extrahepatic bile duct size with age and sex among patients diagnosed with gallstones admitted at PGH.

MATERIALS AND METHODS

Study Design and Setting

This is a prospective cross-sectional study which included patients who have undergone Cholecystectomy with routine intraoperative cholangiography for gallbladder stones under the Division of Hepatobiliary and Pancreatic Surgery (GSIII) of the University of the Philippines – Philippine General Hospital (UP-PGH) from January 2018 to December 2022.

Inclusion Criteria

1. All patients that underwent cholecystectomy, routine intraoperative cholangiography for gallbladder stones.

Exclusion Criteria

1. Patients with history of jaundice and symptoms of biliary obstruction.
2. Abnormal liver function tests: Aspartate aminotransferase (AST), Alanine aminotransferase (ALT), Total Bilirubin (TB), Direct Bilirubin (DB), Indirect Bilirubin (IB), alkaline phosphatase (ALP).
3. Any pathology found intraoperatively that will cause EHBD dilatation such as stone or masses.
4. Intraoperative cholangiography of patients that showed presence of CBC stone or any other cause of biliary obstruction.

Data Collection and Management

The study involved convenience sampling of patients who were admitted for gallstones and had open cholecystectomy and routine intraoperative cholangiography as part of the charity program offered by the Division of Hepatobiliary and Pancreatic Surgery (GSIII) at the University of the Philippines – Philippine General Hospital (UP-PGH) from January 2018 to December 2022. The selection process for our study subjects was based on the accessibility of patients who were already scheduled for the procedure rather than through a systematic or random sampling method. This may not encompass the broader population due to its non-randomized nature but allows for the collection of data from a readily available subset of individuals.

Routine intraoperative cholangiography, as per institutional protocol, is performed independently of specific clinical indicators, to refine the interpretive and technical skills of residents in normal biliary tree assessment. Information about the patients' age and sex was obtained from the official hospital chart. The study excluded patients who underwent laparoscopy because intraoperative cholangiography is not a standard protocol in these subsets of patients in the institution unless there are indications. Intraoperative measurements were performed using an electronic caliper via intraoperative ultrasound by two surgeons prior to conducting the cholangiography. Potential bias concerning operator dependency was addressed, given the intraoperative setting and direct positioning of the ultrasound probe on the bile duct.

The measurements were taken in a transverse and axial manner at the extrahepatic common hepatic duct and at the supraduodenal area of the common bile duct to obtain the anteroposterior and width diameter of the bile duct.

Prior to analysis, the gathered data underwent a thorough verification process to ensure it was complete, accurate, and clearly presented. The data were then encoded into Microsoft® Excel® for Microsoft 365 MSO (Version 2205 Build 16.0.15225.20172) using its 64-bit version and analyzed with the aid of the Excel® Analysis ToolPak. The outcomes were displayed in various descriptive formats such as tables, charts, and narrative text, encompassing frequencies and summary measures. We computed the average values with their standard deviations, the range, and the extreme values, as well as the 95% confidence intervals for the average measures. To evaluate the relationship between the continuous dependent variable of EHBD diameter and the various age categories, an ANOVA test was performed.

Ethical Considerations

This study was approved by the University of the Philippines Manila Research Ethics Board (UPMREB Registration NO. 2018-447- 01) prior to the commencement of the study. Informed consent was obtained from each patient detailing the study and assuring that participation had no effect on their treatment or any additional risks. Sterilized equipment, typical of our surgeries, was utilized, ensuring minimal risk of infection. Patient data remained confidential, securely stored offline, and patients were afforded the option to withdraw or decline data usage at any point. Participation was voluntary, offered no compensation, and non-participation did not alter patient care.

RESULTS

A total of 80 subjects were included in the study. The mean CBD diameter in the study population was 5.17 mm, which is within the normal range of CBD diameter (4-8 mm) reported in the literature. However, it is important to note that there was a wide range of CBD diameters in the study population, with a maximum of 7.3 mm. This finding suggests that there may be some patients with CBD dilatation who may require further investigation or intervention.

The mean CHD diameter in the study population was 4.71 mm, which is also within the normal range (3-5 mm) reported in the literature. However, the maximum CHD diameter in the study population was 7.7 mm, which is larger than the upper limit of normal. This finding suggests that there may be some patients with CHD dilatation who may require further investigation or intervention.

The study also provides important information on the distribution of CHD and CBD diameters across different age groups and genders. Table 1 shows that the majority of patients in the study were female (70%) and the mean age was 44.07 years. The study found no significant difference

Table 1. Baseline Demographic Profile of Patients

Characteristic	Mean	Range (SD)
Age (years)	44.07	50 (1.5)
	Number	(%)
Gender		
Female	56	70
Male	24	30
Age (years)		
19-20	3	3.75
21-30	11	13.75
31-40	20	25.00
41-50	22	27.50
51-60	9	11.25
61-70	15	18.75
	Mean	Range (SD)
Common Hepatic Duct diameter (mm)	4.71	7.7 (1.59)
Common Bile Duct diameter (mm)	5.17	7.3 (1.41)

between genders in both CHD and CBD diameters, which was consistent with previous studies.⁴ However, there was a higher prevalence of patients in the age group of 41-50 years, which suggests that this age group may be at higher risk of developing hepatobiliary diseases.

The mean CHD diameter in the study population was 4.71 mm as shown in Table 2, which was within the normal range (3-6 mm) reported in the literature.⁷ The study found no significant difference in the mean CHD diameter between females and males, which suggested that gender did not significantly influence the diameter of the CHD. Similarly, the study found no significant difference in the mean CHD diameter across different age groups. The highest mean CHD diameter was observed in the 51-60 age group (5.34 mm), but this difference was not statistically significant.

The mean CBD diameter in the study population was 5.17 mm as depicted in Table 3, which was within the normal range (4-6 mm) reported in the literature. The study found no significant difference in the mean CBD diameter between females and males, which suggested that gender did not significantly influence the diameter of the CBD.

Similarly, the study found no significant difference in the mean CBD diameter across different age groups. Although the highest mean CBD diameter was observed in the 51-60 age group (5.91 mm), this difference was not statistically significant.

DISCUSSION

Biliary stone disease is a common problem in the Philippines, and it can lead to various complications such as biliary colic pain, pancreatitis, cholecystitis, and cholangitis. The extrahepatic bile duct diameter is an important factor to consider when diagnosing and managing biliary stone disease. This study provides initial data on the diameter of a normal EHBD measurement in a Filipino population diagnosed

Table 2. Mean and Standard Deviation of Common Hepatic Duct Diameter by Age Group

Characteristic	Mean CHD diameter (mm)	P-value
Gender		<i>p</i> = 0.84
Female	4.73	
Male	4.65	
Age (years)		<i>p</i> = 0.71
19-20	4.17	
21-30	4.24	
31-40	4.82	
41-50	4.60	
51-60	5.34	
61-70	4.79	

Table 3. Mean and Standard Deviation of Common Bile Duct Diameter by Age Group

Characteristic	Mean CBD diameter (mm)	P-value
Gender		<i>p</i> = 0.9
Female	5.17	
Male	5.15	
Age (years)		<i>p</i> = 0.46
19-20	4.50	
21-30	4.85	
31-40	5.39	
41-50	4.98	
51-60	5.91	
61-70	5.07	

with cholecystolithiasis without signs of obstruction. The normal diameter of the EHBD varies among individuals and may be influenced by factors such as age⁸, gender, and race. The measurement of the EHBD diameter is an important diagnostic tool in the evaluation of biliary tract disease.

The results of the study showed that the mean CHD diameter among patients diagnosed with cholecystolithiasis managed at the Philippine General Hospital was 4.71 mm, with a range of 2.7- 10 mm (1.59 mm). Meanwhile, the mean common bile duct (CBD) diameter was 5.17 mm, with a range of 2.3- 10 mm (1.41 mm). The results also showed that there was no significant difference in CHD and CBD diameters among males and females (*p* = 0.84 and *p* = 0.9, respectively) and across different age groups (*p* = 0.71 and *p* = 0.46, respectively).

Comparing the results from worldwide studies, the present study found that among patients diagnosed with cholecystolithiasis, the mean CHD diameter was 4.71 mm and the mean CBD diameter was 5.17 mm, with no significant difference in diameter between genders or age groups. In the seminal study by Graham et al.⁷, the normal internal diameter of the common hepatic duct post-cholecystectomy was established to be 4 mm or less, which was observed in 84% of the patients. The present study's findings align with these historical parameters, showing an average common hepatic duct diameter of 4.71 mm. While a minority of patients in the present study did exhibit measurements larger than 4 mm, this occurrence falls within the expected variance noted by Graham et al., where up to 16% of patients could have duct sizes up to 10 mm without clinical signs of pathology. This correlation substantiates the established range for normal postoperative common hepatic duct size and reinforces the threshold of 5 mm as a potential indicator of borderline dilatation.

A study by Govindan et al.⁹ investigated whether CBD diameter increases with age and if gallstones cause changes in CBD diameter, and found that while the CBD diameter does increase with age at a rate of 0.07 mm/year, there was no significant difference in CBD size between the general population and cholelithiasis patients at any age. Therefore,

both studies contribute to our understanding of the normal range of CHD and CBD diameters, and the potential impact of gallstones on CBD diameter. Overall, both statements suggest that cholecystolithiasis does not have a significant impact on CBD diameter, while age has a physiological impact on CBD diameter.

These findings are in line with previous research conducted worldwide. For example, a study in Italy by Worku et al.¹⁰ found that the average CHD diameter among patients with cholecystolithiasis was 5.5 mm. In addition, Benjaminov et al.¹¹ conducted a study in Israel on the impact of age and cholecystectomy on the CBD diameter as measured by endoscopic ultrasonography. The study involved 647 patients, and the results showed that age was a significant factor in CBD diameter, which increased with age. Furthermore, previous cholecystectomy was associated with a larger CBD diameter.

Both studies, our present study and a study conducted in Colombia¹², respectively, aim to evaluate the size of the common bile duct (CBD) in patients with or without cholecystolithiasis or gallbladders (post-surgery), and provide important insights into the potential clinical implications of CBD size. While the present study offers detailed numerical data on both CHD and CBD size and found no significant differences among genders and age groups, the second study, which used endoscopic ultrasound, found a smaller average CBD size in patients who did not undergo cholecystectomy and suggested the potential utility of this smaller size in discarding biliopancreatic pathology with diagnostic endoscopic ultrasonography.

The study conducted by Ahmed et al.¹³ in Egypt found that the diameter of the common bile duct increased significantly with age and was larger in men than in women, whereas the present study conducted at the Philippine General Hospital showed no significant difference in common hepatic duct and common bile duct (diameters among males and females and across different age groups, but reported a mean CHD diameter of 4.71 mm and mean CBD diameter of 5.17 mm in patients with cholecystolithiasis.

Lal et al.⁴ conducted a study to determine the normal sonographically measured diameters of the common bile duct and its correlation with age, sex, and anthropometry in 200 participants. The mean diameters of the common bile duct were 4.0 mm, 4.1 mm, and 4.2 mm at different locations, with an overall mean of 4.1 mm. The upper limit of normality was reported as 7.9 mm, with the diameter increasing with age. The study found no significant correlation between the diameter and anthropometric measurements. The study's findings align with previous studies worldwide, suggesting that the normal CBD diameter in the specific population with cholecystolithiasis is similar to other populations.

Overall, the literature suggests that the normal CBD diameter in the Filipino population with cholecystolithiasis is similar to that of other populations, and that intraoperative measurements, intraoperative ultrasonography, MRCP, and ERCP are reliable methods for measuring CBD diameter. However, further studies are needed to confirm these findings and to determine the normal EHBD diameter in the general Filipino population.

The study's limitation is its small sample size, confined to patients diagnosed with cholecystolithiasis from a single institution, which is not reflective of the general population. Validation of these findings requires further research with larger, more diverse samples.

CONCLUSION

In conclusion, the study aimed to provide an overview of the average range of the common hepatic duct (CHD) and common bile duct (CBD) diameters among Filipino patients with cholecystolithiasis with no evidence of EHBD obstruction, as measured through intraoperative ultrasonography. The present study found no significant difference in CHD and CBD diameters based on gender and age among patients diagnosed with cholecystolithiasis in the Philippine General Hospital. This study provides important insights into the relationship between gender, age, and EBHD diameter. The information provided by the study is essential in the clinical management of patients with gallstone disease, particularly in the selection of appropriate treatment modalities.

However, further studies with a larger sample size are warranted to validate the present findings and to determine the normal range of CHD and CBD diameters among the general population in the Philippines.

Statement of Authorship

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Author Disclosure

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