



Frequency of Common Bile Duct Dilatation After Cholecystectomy for Chronic Cholecystitis

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Abstract

Introduction: Although the common bile duct (CBD) is generally believed to dilate after surgery, postcholecystectomy dilatation of the common duct continues to be a matter of controversy in the surgical, radiographic, and sonographic literature. The introduction of intravenous cholangiography enabled the direct measurement of the common bile duct. Prospective studies using sonography to measure the common duct have shown that, although most patients did not experience a significant increase in duct diameter after cholecystectomy, there was a trend toward minor duct dilatation.

Objective: To determine the frequency of common bile duct dilatation after cholecystectomy for chronic cholecystitis.

Study Duration: From 4 September 2020 to 5 March 2021.

Study Design: Descriptive study

Study setting: Surgery Department, Hayatabad Medical Complex, Peshawar.

Materials and Methods: A total of 139 patients subjected to cholecystectomy were included in the study and followed up to determine the frequency of common bile duct dilatation.

Results: The mean age of the whole study sample was 38.6 ± 10.3 years. In our study, we had 55.4% male and 44.6% females. Mean BMI of the sample was 25 ± 2.3 kg/m². Mean duration of cholecystitis was 3.6 ± 1.5 months. 54.7% belonged to ASA class II, and 59.7% were subjected to LC. Mean baseline CBD diameter on US was 1.3 ± 0.1 mm while the mean follow-up CBD diameter was 1.8 ± 0.2 mm ($p < 0.001$). As per operational definitions, CBD dilatation was recorded in 23% of patients.

Conclusion: CBD dilatation after cholecystectomy is highly common in our patients; however, not significantly associated with gender, age, type of cholecystectomy or baseline diameter of CBD. Further studies are recommended on the relationship between CBD dilatation and its outcome among patients after cholecystectomy. Moreover, more studies should be conducted on the Identification of preventive measures to be adopted for controlling dilatation of the CBD after cholecystectomy

Key Words: Cholecystectomy, cholecystitis, common bile duct dilatation, body mass index.

Introduction

Gallstone disease accounts for the most common biliary tract disease throughout the world, affecting almost 12% of the population in the United States and 18.5% in the Europe[1]. The majority of patients harboring gallstones, though asymptomatic, still carry a risk of developing complications (1-2%)[2]. Laparoscopic cholecystectomy (LC), regarded as the gold standard, being a very common modality of treatment, is undergoing rapid improvement with the advent of newer technologies[3,4].

Although the common bile duct (CBD) is generally believed to dilate after surgery, postcholecystectomy dilatation of the common duct continues to be a matter of controversy in the surgical, radiographic, and sonographic literature[5]. The introduction of intravenous cholangiography enabled the direct measurement of the common bile duct. Prospective studies using sonography to measure the common duct showed that although most patients did not have a significant increase in the duct diameter after cholecystectomy, there was a trend toward a minor degree of duct dilatation[6].

Different factors influencing the post-cholecystectomy CBD diameter have been implicated. Ultrasound has emerged as a diagnostic imaging method of choice for the liver and extrahepatic biliary system[7]. Post-operative immediate viewing of the changing structure is a characteristic feature of ultrasound. The normal range of CBD size depends on age. In infancy, the normal CBD size should be <2 mm, <4 mm in childhood, and <7 mm after adolescence[8].

Radiologists can be confronted with unanticipated dilated extrahepatic CBDs in patients in whom the necessity for further cholestatic investigation is unclear. Hence, knowing whether it is expected that patients who had a cholecystectomy, who do not present with cholestasis, have more prominent CBDs than the general population would be of value and help prevent unnecessary further, potentially invasive and costly, investigation of the biliary system[9].

In one previous study, the mean preoperative diameter was 4.12mm, postoperatively, the mean diameter of the CBD in early follow up period i.e. at 10th day and at 3 months, was found to be 4.75 and 5.14 mm respectively. At 3 months follow-up, 10% of patients had mean increase in CBD diameter of 3.14mm[10]. In another study, the number of cases of CBD dilatation of more than 7 mm at 6 months and at 12 months after cholecystectomy were 24.4% and 29.0% respectively[11].

The present study will provide us with local statistics of the CBD dilatation after cholecystectomy. As mentioned above, CBD dilatation is not an uncommon problem after cholecystectomy and studies on it are very rarely conducted in the Pakistani context. Moreover, CBD dilatation after cholecystectomy is not thoroughly investigated and controversy exists as some studies report its fair dilatation while other do not, and the results of this will give us the local magnitude of the problem as to know whether there is difference as compared to other international literature or not. This study will highlight the magnitude of CBD dilatation

after cholecystectomy in our local population and the results will be shared with other local health professionals to guide them about future research priorities and future recommendations of screening of CBD size after cholecystectomy.

Materials and Methods

Study Design: Descriptive study

Setting: Surgery Department, Hayatabad Medical Complex, Peshawar.

Duration of Study: Minimum of six months from date of approval of synopsis.

From 4 September 2020 to 5 March 2021.

Sample Size: Sample size was 139 using 10%10 proportion of common bile duct dilatation after cholecystectomy, 95% confidence interval and 5% margin of error using WHO sample size estimation formula.

Sampling Technique: Non probability (consecutive) sampling

Sample Selection

Inclusion Criteria:

1. All patients with chronic cholecystitis presenting scheduled for cholecystectomy (both open and laparoscopic)

2. Duration of chronic cholecystitis of more than 3 months

Age group 20-60 years and either gender.

Patients with CBD size of less than 7mm on US.

ASA Class I and II.

BMI of less than 30kg/m²

Exclusion Criteria:

Patients with history of any other abdominal surgery involving the biliary tract.

Patients with ERCP in last 6 months.

The above mentioned conditions act as confounders and if included will introduce bias in the study results.

Data Collection Procedure

The study was conducted after approval from hospitals ethical and research committee. All patients meeting the inclusion criteria i.e. patient with chronic cholecystitis scheduled for cholecystectomy (open or laparoscopic) was included in the study through OPD and was admitted in the surgical department for further evaluation. The purpose and benefits of the study was explained to the patients and they were assured of the research purpose and a written informed consent was obtained.

Preoperative US was done in all patients to check and record the CBD size. All patients were subjected to cholecystectomy. All the cholecystectomies were conducted by single experienced surgeon fellow of CPSP having minimum of five years of experience. After cholecystectomy, all patients were sent home on routine medication on 1st post-operative day. A check ultrasound was done at 10th post operative day to measure the CBD size and detect CBD dilatation.

All the above mentioned information including name, age, gender and address was recorded in a predesigned proforma. Strictly exclusion criteria was followed to control confounders and bias in the study results.

Data Analysis Procedure

The data was analyzed with SPSS version 20. Frequency and percentages were computed for categorical variables such as gender, type of cholecystectomy and CBD dilatation while numerical variables such as age, height, weight, BMI, baseline CBD size and follow up CBD size, were presented as Mean \pm SD. Chi square was used to stratify the CBD dilatation in terms of age, BMI, type of cholecystectomy, baseline size of CBD and gender with $P \leq 0.05$ taken as significant. All results were presented in the form of tables and graphs.

Results

The study was conducted on 139 patients scheduled for cholecystectomy (open or LC) for cholecystitis.

The mean age of the whole study sample was 38.6 ± 10.3 years. We categorized the age in 4 different categories. (See table 1)

In our study, we had 55.4% male and 44.6% females. (Table 2). Mean BMI of the sample was 25 ± 2.3 kg/m² (See table 3). Mean duration of cholecystitis was 3.6 ± 1.5 months (table 4). 54.7% belonged to ASA class II (table 5) and 59.7% were subjected to LC (table 6). Mean baseline CBD diameter on US was 1.3 ± 0.1 mm (see table 7 for categories) and mean follow up CBD diameter was 1.8 ± 0.2 mm ($p < 0.001$). See table 8 for comparison of baseline and follow up CBD).

As per operational definitions, CBD dilatation was recorded in 23% of patients (table 9).

The subsequent table elaborates age, gender, BMI, duration of cholecystitis, ASA class, type of cholecystectomy and baseline CBD diameter wise stratification of CBD dilatation.

Age groups	Frequency	Percent
22-30 years	34	24.5
> 30-40 years	44	31.7
> 40-50 years	43	30.9
> 50-60 years	18	12.9
Total	139	100.0

Table no. 1: Age Wise Distriubtion of Sample (n = 139)

Gender	Frequency	Percent
Male	77	55.4
Female	62	44.6
Total	139	100.0

Table No. 2: Gender Wise Distribution of Sample (n = 139)

BMI (kg/m ²)	Frequency	Percent
20-23	41	29.5
> 23-27	70	50.4
> 27-29	28	20.1
Total	139	100.0

Table No: 3: Body Mass Index of Sample (n=139)

Duration of symptoms	Frequency	Percent
1-3 months	70	50.4
> 3-6 months	69	49.6
Total	139	100.0

Table no. 4: Duration of Cholecystitis (n = 139)

ASA class	Frequency	Percent
ASA I	63	45.3
ASA II	76	54.7
Total	139	100.0

Table no. 5: ASA Class of Samle (n = 139)

Type of Cholecystectomy	Frequency	Percent
Open	56	40.3
LC	83	59.7
Total	139	100.0

Table no. 6: Type of Cholecystectomy (n = 139)

Baseline size of CBD	Frequency	Percent
2-4mm	112	80.6
> 4-6mm	27	19.4
Total	139	100.0

Table no. 7: Baseline Common Bile Duct Diameter (n = 139)

	Mean	SD	P value
Baseline CBD	3.6	1.3	< 0.001
Follow up CBD	5.2	1.8	

Table no. 8: Comparison of Baseline and Follow Up CBD Diameter (n = 139)

CBD Dilatation	Frequency	Percent
Yes	32	23.0
No	107	77.0
Total	139	100.0

Table no. 9: Frequency of CBD Dilatation (n = 139)

	CBD Dilatation		P value
	Yes	No	
22-30 years	10 29.4%	24 70.6%	0.586
> 30-40 years	8 18.2%	36 81.8%	
> 40-50 years	11 25.6%	32 74.4%	
> 50-60 years	3 16.7%	15 83.3%	
Total	32 23.0%	107 77.0%	

Table no. 10: Age Groups Wise Stratiification Of Cbd Dilatation

	CBD Dilatation		P value
	Yes	No	
Male	19 24.7%	58 75.3%	0.606
Female	13 21.0%	49 79.0%	
Total	32 23.0%	107 77.0%	

Table no. 11: Gender wise stratiification of CBD dilatation

	CBD Dilatation		P value
	Yes	No	
20-23	11 26.8%	30 73.2%	0.788
> 23-27	15 21.4%	55 78.6%	
BMI Categories > 27-29	6 21.4%	22 78.6%	
Total	32 23.0%	107 77.0%	

Table no. 12: BMI wise stratification of CBD dilatation

	CBD Dilatation		P value
	Yes	No	
1-3 months	20 28.6%	50 71.4%	0.117
Duration of cholecystitis > 3-6 months	12 17.4%	57 82.6%	
Total	32 23.0%	107 77.0%	

Table no. 13: Duration of Cholecystitis Wise Stratification of CBD Dilatation

		CBD Dilatation		Total
		Yes	No	
ASA at presentation	ASA I	14 22.2%	49 77.8%	0.839
	ASA II	18 23.7%	58 76.3%	
Total		32 23.0%	107 77.0%	

Table no. 14: ASA Class Wise Stratiification of CBD Dilatation

		CBD Dilatation		P value
		Yes	No	
Type of Cholecystectomy	Open	11 19.6%	45 80.4%	0.438
	LC	21 25.3%	62 74.7%	
Total		32 23.0%	107 77.0%	

Table no. 15: Type of Cholecystectomy Wise Stratiification of CBD Dilatation

	CBD Dilatation		P value	
	Yes	No		
Baseline size of CBD	2-4mm	26 23.2%	86 76.8%	0.912
	> 4-6mm	6 22.2%	21 77.8%	
Total	32 23.0%	107 77.0%		

Table no. 16: Baseline Size of CBD Wise Stratiification of CBD Dilatation

Discussion

As abdominal ultrasonographic exams are frequently performed, bile duct dilatations are incidentally found in gallbladder resected patients. When bile duct dilatation is discovered in asymptomatic patients, it is often difficult to differentiate whether it is the physiological change of gallbladder resection or the early findings of bile duct lesions. In order to differentiate the diagnosis of asymptomatic bile duct dilatation, one needs to perform magnetic resonance cholangiopancreatography or endoscopic retrograde cholangiopancreatography (ERCP), which are both expensive and/or invasive tests. Therefore, it is necessary to understand the physiological change of the bile duct after cholecystectomy to reduce unnecessary testing for the early detection of bile duct lesions.

After a hypothesis suggested by Oddi in 1887, many studies reported that the physiological dilatation of the bile duct after cholecystectomy was due to the disappearance of the gallbladder's reservoir function. However, the frequency and degree of bile duct dilatation after gallbladder resection are reported differently. In addition, since most of the reported studies were based on the western population, it is assumed that these results may be different in the eastern population, who frequently show anomalous union of pancreaticobiliary duct (AUPBD) and a high incidence of bile duct stones. However, there have only been a few studies reported thus far.

The hypothesis of bile duct dilatation as a physiological change that results from the resection of gallbladder was initiated in the 1880s. Suggesting that CBD dilatation was due to the loss of the storing function of the gallbladder after its resection was confirmed in an animal experiment[136]. Then, dilatation of the bile duct

was proved in the case of gallbladder resection compared to normal cases of human autopsy samples[137]. Afterward, studies measuring bile duct diameter were performed using intravenous cholangiography. However, contrary to these findings, the bile duct diameter remained the same or on the contrary decreased, while the increase was observed only in limited patients[138-140]. After introducing the abdominal ultrasonography that enables the direct measurement of bile duct diameter in a normal state, the study mainly used this method. The occurrence of a physiological change of the bile duct after cholecystectomy was confirmed by a cross sectional study.

Although many cross sectional studies revealed CBD diameter increase in gallbladder resected patients compared to normal people, the magnitudes and frequencies of dilatation are different according to each study. One study reported a CBD diameter of 4.5 mm in the gallbladder resected group by showing a slight difference of 0.7 mm dilatation from the normal subjects' 3.7 mm[141]. Another study reported a dramatically increased CBD diameter of 6.2 mm in the gallbladder resected group compared to that of 2.8 mm in normal subjects[142]. In a recent study, the gallbladder resected group revealed a bile duct dilatation of more than 6 mm, which was observed at 80% of the proximal part and 58% of the distal part of the CBD[143]. Since the cross sectional study presents the possibility that bile duct dilatation is related with bile duct diseases before surgery, there is a limitation that the dilatation was purely caused by physiologic changes from the cholecystectomy.

In prospective studies that can represent the direct change of the bile duct after gallbladder resection, the bile duct dilatation occurred in a limited number of patients, revealed by the different results of the 16-month follow-up study, 7 out of 67 patients revealed a dilatation of up to 6 to 10 mm[144], but there was also a report that showed a dilatation in only a single case out of 40 patients[145]. Similar results were reported in the more long-term observational studies. The result of a 5 year follow-up for 21 patients after surgery revealed that only 2 patients showed a common hepatic duct dilatation of about 4 mm, and 7 patients showed a slight change of CBD diameter from 4.8 to 5.9 mm[146].

In other studies investigating patients showing normal gallbladder function and a CBD diameter up to 5 years after surgery, results showed common hepatic duct dilatation of more than 6.0 mm in only a single case out of 59 patients[147]. The longest follow-up observational study, which investigated bile duct dilatation up to 12 years after the cholecystectomy, reported that patients who were 60 years of age or older revealed a significant increase from 5.0 to 6.7 mm, but there was no difference for those under 60 years old[148]. When integrating the above results, most of the patients showed a bile duct dilatation after gallbladder resection in the normal range and only a limited number of patients showed a dilatation higher than normal range.

In studies involving eastern populations, a cross sectional study investigating the CBD diameter by using abdominal ultrasonography of Korean patients revealed the CBD diameter was 8.1 mm in the gallbladder

resected group, which was wider than the 4.5 mm in the normal population[149]. One prospective study performed in Hong-Kong, investigating the CBD diameter before and after cholecystectomy by ERCP, revealed that 88.6% of 35 patients showed a dilatation of about 2.0 mm, and the degree of dilatation increased proportionally to time passed for the period of 4 to 14 months[150]. However, in a Taiwanese study, 197 patients revealed a slight CBD dilatation from 5.9 to 6.1 mm, and the degree of dilatation was not related to time passage[151]. Since the above studies on eastern populations applied different imaging techniques and showed different results, bile duct change after gallbladder resection still remains in dispute.

In the present study, 23% of the patients displayed more than a 3 mm dilatation compared to that before surgery. These results showed more CBD dilatation and frequency than previous studies. Eastern populations showed that the CBD dilatation was frequently accompanied by ampullary diverticulum, biliary sludge, or AUPBD.

Next, what clinical characteristics can be observed in the patients of bile duct dilatation after the cholecystectomy? Although the general clinical characteristics of bile duct dilatation have not been well defined, some reports showed that it is commonly observed when the initial diameter of the bile duct is smaller before surgery[152] and when the patient is older[148]. But in the present study, the patients' age, sex, and baseline bile duct diameter did not have effect on the bile duct dilatation after surgery.

Although there is no official guideline, a bile duct diameter of less than 6 mm is generally considered to be a normal size in adults younger than 65 years of age, and more than 7 mm is considered abnormal[153]. Bile duct size is not largely affected by sex, body weight and height of the patient, but reported to have a major correlation with age as there was an increase of 0.3 to 0.6 mm for patients of 10 years difference[154, 155]. According to a study that investigated the CBD diameter of 230 healthy Koreans, results showed that they had CBD diameters of 4.5 ± 1.8 mm while 95% of the investigated populations had less than 7.3 mm[149]. The present study was performed on patients with CBD diameters of less than 7 mm before surgery in order to investigate the degree of dilatation after surgery of normal people. At follow up after surgery, a more than 3mm of dilatation was observed in 23% of the total patients.

Conclusion

CBD dilatation after cholecystectomy is highly common in our patients however, not significantly associated with gender, age, type of cholecystectomy or baseline diameter of CBD. Further studies are recommended on relationship between CBD dilatation and its outcome among patients after cholecystectomy. Moreover, more studies should be conducted on the identification of preventive measures to be adopted for controlling dilatation of CBD after cholecystectomy.

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