

A prospective study to determine the effect of cholecystectomy on common bile duct diameter in Indian population

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Abstract

Background and Aim: Though increase in the common bile duct (CBD) diameter has been attributed to previous cholecystectomy, this relationship continues to be controversial. Our objective was to evaluate the relationship between cholecystectomy and change in CBD diameter, as measured by ultrasonography.

Methods: A total of 50 cases (age, 44.0 ± 12.4 years; men, 8; women, 42) were admitted with symptomatic cholelithiasis and normal bile duct diameters. They underwent cholecystectomy, and the CBD diameter was measured by single diagnostician using ultrasonography at the widest point after full-length evaluation of CBD. Follow-up ultrasound at 2 months and 4 months postoperatively was done in all cases.

Results: Mean preoperative CBD diameter observed was 5.12 ± 0.97 mm and mean postoperative CBD diameter observed at 2 months and 4 months interval were 6.79 ± 1.23 mm (32.61% increase; $P < 0.0001$) and 7.1 ± 1.28 mm (38.47% increase; $P < 0.001$), respectively. There was a rise in number of patients with CBD diameter of >6.5 mm from nil to 19 (38%) and 25 (50%) at 2 months and 4 months, respectively. CBD dilatation was observed to be age-dependent with mean postoperative diameter increase of 3.37 mm in patients with age >50 years.

Conclusion: The present study confirms that the CBD dilates significantly after cholecystectomy. The postcholecystectomy, CBD diameter does not exceed 10 mm. Thus, a wider CBD following cholecystectomy may warrant further investigation to know the etiology.

Key words: Cholecystectomy, common bile duct, dilatation, ultrasound

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INTRODUCTION

Bile duct dilatation is an incidental finding in postcholecystectomy patients on ultrasonography. It's often difficult to differentiate in asymptomatic patients that whether this is a physiological response to cholecystectomy or an early finding of bile duct pathology. Hence, it is necessary to understand the

physiological change of the bile duct that occurs after cholecystectomy to avoid unwarranted diagnostic and therapeutic procedure on common bile duct (CBD). Since Oddi postulated that choledochus dilates after cholecystectomy,^[1] many studies have been conducted to understand the physiology behind the fact. The dilemma of this fact still remains as many studies which showed a significant increase in diameter;^[2] were challenged by studies which denies such physiological response of the CBD after cholecystectomy.^[3-6] Furthermore, these studies have data from the western population, and only a few studies have been reported from the eastern population, where the anomalous union of pancreatico-biliary duct (AUPBD) and bile duct stones have a high incidence.^[7,8] The present study was conducted to determine the physiological effect of cholecystectomy on CBD diameter using ultrasonography.

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MATERIALS AND METHODS

A total of 50 patients who were admitted to undergo cholecystectomy (open or laparoscopic) for cholelithiasis during February 2013 to November 2013 were randomly selected. Study excluded the patients with acute cholecystitis, choledocholithiasis, malignant tumor of gall bladder with history of jaundice and patients who previously underwent abdominal surgeries or endoscopic retrograde cholangiopancreatography (ERCP). Detailed history and examination were performed, and patients were investigated for surgery. The change in CBD diameter from preoperative, 2 months and 4 months after surgery was measured in the same patient. This was done by the same diagnostician using the same highly accurate ultrasound machine (Phillips HD 11 XE, the Netherlands). The CBD diameter was measured in 0.1 mm scale at the widest point of CBD. The mean preoperative and postoperative diameter with a standard deviation was calculated. The change of CBD diameter was expressed in percentages (%), based on the measurements before the surgery and during the follow-up periods. Number of patients with CBD diameter <5 mm, 5–6.5 mm and >6.5 mm were compared preoperative and postoperatively. Patients were divided into three age groups as <30 years; 30–50 years and >50 years and relation with a mean change in CBD diameter was observed.

Statistical analysis of data

The CBD diameters that were measured at each point were expressed as mean, and standard deviation and the change was scrutinized by *t*-test. The changes of a single patient before, 2 months after, and 4 months after the surgery were analyzed using a paired *t*-test wherein the *P* value results of <0.05 were interpreted as significant.

RESULTS

A total of 50 patients who were selected had a mean age of 44.0 ± 12.4 years (range, 25 years to 72 years). There were eight males and 42 females in the study group with male to female ratio of 1:5, showing female preponderance. All the patients came for follow-up ultrasonography with no defaulters or deaths.

The preoperative mean CBD diameter in the study group was 5.12 ± 0.97 mm, at 2 months postoperative interval was 6.79 ± 1.23 mm and at 4 months interval was 7.1 ± 1.28 mm as shown in Figure 1. The mean postoperative dilatation observed at 2 months and at 4 months interval is 1.67 mm and 1.94 mm, respectively, and was found to be highly significant ($P < 0.001$). The net dilatation (i.e., the average of the two postoperative readings of the CBD diameter – mean preoperative CBD diameter) is 1.82 mm.

Before surgery, 46% of patients had a CBD diameter of <5 mm while 54% of patients were in the 5–6.5 mm range. 2 months after surgery 18% had CBD diameter measurements of <5 mm while 44% measured 5.1–6.5 mm [Table 1 and Figure 2]. In 19 patients (38%), the CBD diameter was >6.5 mm (range, 6.6–8.8 mm). 4 months after surgery only 8% had <5 mm and 42% ranged from 5 to 6.5 mm. In 25 patients (50%), the CBD diameter was >6.5 mm (range, 6.9–9.7 mm), but no patient had a measurement of >10 mm. The CBD diameters before, at 2 months and at 4 months after surgery show an increase of 32.61% and 38.47%, respectively (baseline vs. post 2 months, $P < 0.0001$; baseline vs. post 4 months, $P < 0.001$; by paired *t*-test). Change in diameter between 2 months and 4 months had an increase of 4.56% ($P < 0.001$).

Patients were divided into three age groups, and the mean increase of CBD diameter was observed. Group I (<30 years) had a mean preoperative diameter of 5.26 mm and mean postoperative diameter of 6.55 mm. Group II (30–50 years) had a mean preoperative diameter of 4.96 mm and mean postoperative diameter of 6.31 mm. Group III (>50 years) had a mean preoperative diameter of 4.85 mm and mean postoperative diameter of 8.22 mm. Therefore, it shows that age has a direct relationship with change in CBD diameter after cholecystectomy and age >50 years showed the maximum increase of 3.37 mm [Figure 3].

Gender and type of cholecystectomy (open or laparoscopic) had no significant bearing on CBD diameter

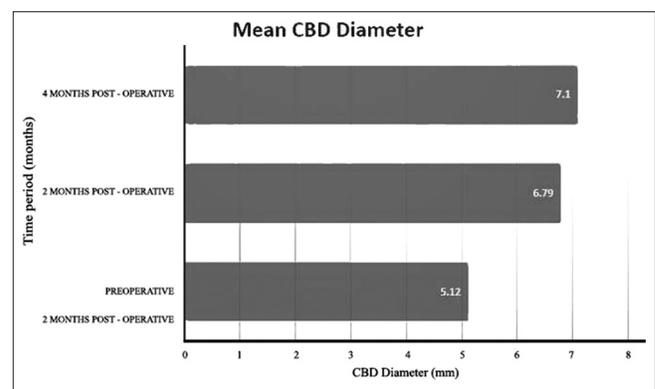


Figure 1: Change of mean common bile duct diameter during various time intervals

Table 1: Common bile duct diameter at preoperative and at 2 months and 4 months after cholecystectomy

Time	Common bile duct diameter (mm)		
	≤5	5.1-6.9	7.0-10
Preoperative	23	27	0
Post 2 months	9	22	19
Post 4 months	4	21	25

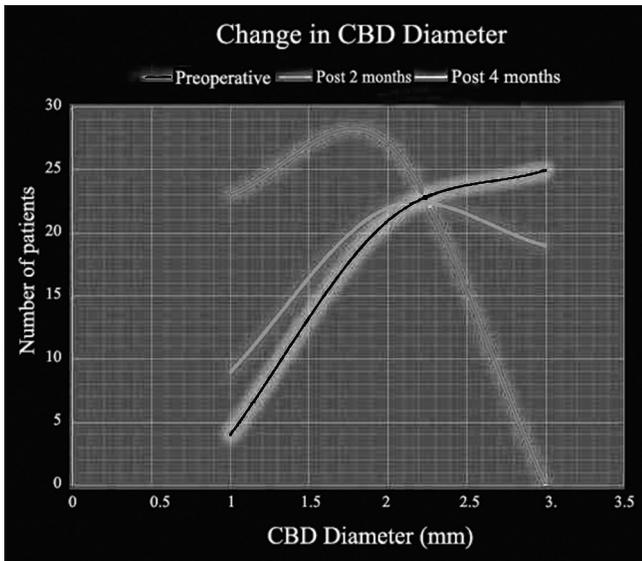


Figure 2: Graphical representation showing increase in the number of patients with wider diameter range at different time intervals of follow-up

[Tables 2 and 3]. All the patients remained asymptomatic during the follow-up period with normal clinical examination, ultrasonography, and liver function tests.

DISCUSSION

Oddi, in 1887, first hypothesized the dilatation of bile ducts after removing the gall bladder in animals while determining the functional importance of gall bladder.^[1] Followed which Puestow and Morrison confirmed dilatation of bile ducts after cholecystectomy in humans through autopsies.^[2] Since then many studies using intravenous cholangiography were conducted in live subjects showing variable results from insignificant increase of diameter to a mild decrease in the diameter after cholecystectomy, which made the hypothesis controversial.^[3-6,9-11] However, the accuracy of intravenous cholangiography was doubtful due to the choleretic effect of the infusion which in itself might cause biliary distension, and the magnification effect of X-ray may increase the margin of error of measurement.^[12] Ultrasonography is a novel technique as it visualizes and directly measures the diameter of CBD accurately; secondly there is no risk of radiation or adverse effect; and lastly it is easily available, cheap and most commonly used investigation. Several studies which measured CBD diameter using ultrasonography though showed significant increase in CBD diameter, the increase was ≤ 1 mm.^[13-17] These results were inconclusive as the observer error, and respiratory variation on ultrasonographic measurement are also known to be 1 mm.^[18] Though some sonological studies showed an increase of >3 mm,^[14,19] other few did not exhibit any significant increase in diameter.^[20-22] Hence, the fact remained debatable.

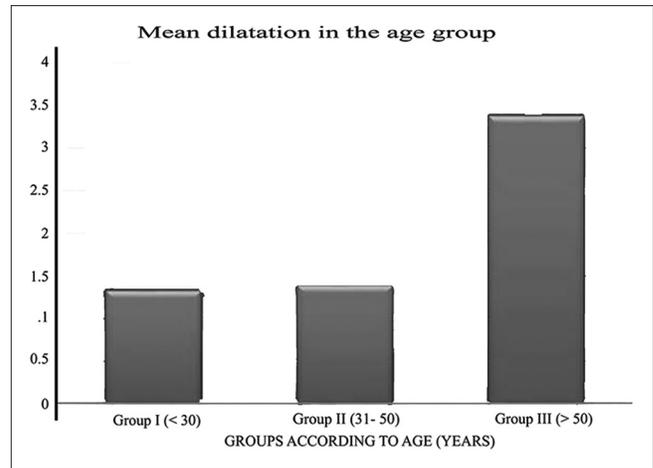


Figure 3: Effect of cholecystectomy on different age groups showing significant increase in diameter in age group >50 years

Table 2: Gender did not show any significant difference on the average increase of common bile duct diameter

Gender	Average increase in CBD diameter (mm)
Male (8)	2.11
Female (42)	2.08

CBD: Common bile duct

Table 3: Type of cholecystectomy also did not showed any significant difference on the average increase of common bile duct diameter

Type of cholecystectomy	Average increase in CBD Diameter (mm)
Open (36)	2.03
Laparoscopic (14)	2.13

CBD: Common bile duct

Role of recent armamentarium imaging like endoscopic ultrasound computed tomography, and magnetic resonance cholangiopancreatography (MRCP) may not draw similar results.^[23-25] However, more studies using these modalities and larger population size are needed to come to a conclusion. Furthermore, these techniques are either invasive or/and expensive investigations, which contradicts the sole purpose of the present study to prevent postcholecystectomy patient to undergo such investigations. When integrating the above results, most of the patients showed a bile duct dilatation after cholecystectomy in the normal range and only a limited number of patients showed a dilatation higher than normal range.

Most of these reported studies were conducted in the western population, and it is assumed that these results may be different in the eastern population who frequently show AUPBD and a high incidence of bile duct stones. In cross-sectional studies involving eastern population, an increase in CBD diameter of >2 mm between normal

and cholecystectomized patients was observed using ultrasonography.^[26-28] However, in a Taiwanese study, only a slight CBD dilatation from 5.9 to 6.1 mm was revealed, and the degree of dilatation was not related to time passage.^[17] From India, this is probably a maiden study as per the literature available. Since the above studies on eastern population applied different imaging techniques and showed different results, bile duct diameter change after cholecystectomy still remains a matter of dispute.

Present study showed a mean increase of 1.67 and 1.94 mm in CBD diameter at 2 and 4 months after cholecystectomy, respectively, with an increase of >2.5 mm in 22% of patients. These results showed more CBD dilatation and frequency than previous studies. In eastern population, CBD dilatation is frequently accompanied by ampullary diverticulum, biliary calculi, or AUPBD. However, the patients showing biliary dilatation in the present study were asymptomatic with normal liver function tests. Precision of the study was confirmed by firstly making clear exclusion criteria to include only asymptomatic patients so that the increase in the diameter in these cases will be totally physiological. Second, tests were performed by a single skilled diagnostician using the same Phillips HD 11 XE machine to measure CBD at the widest point after repeated measurements which gives more meaningful and accurate value. Third, the time period of follow-up was early physiological change at 2 months and late physiological change at 4 months. This has been shown in previous studies that period of 3 months is the stage of transition.^[29,30] Age >50 years show the mean dilatation of 3.37 mm compared to 1.29 mm and 1.35 mm increase in diameter in patients of age group <30 years and 30–50 years, respectively. Similar results were observed in the studies conducted by Hunt *et al.*^[31,32] This accretion of the diameter could be attributed to the age-related weakness of bile duct wall because of decreased elastin fibers and smooth muscle fibers. Physiological response of CBD to dilate after cholecystectomy is a misunderstood fact leading to unnecessary expensive and/or invasive investigations such as MRCP, ERCP, etc., to rule out early biliary pathology. Thus, this study confirms significant increase in CBD diameter after cholecystectomy, with the upper limit of 10 mm on ultrasonography.

Limitations of the study

Though the present study depicts progressive increase in CBD diameter until 4 months, the patients were not followed after 4 months to confirm whether patients crossed the upper limit of dilation (10 mm). Furthermore, the sample size was moderate. Therefore, future studies should be conducted on a larger sample size and for longer postoperative period until there is no further increase in the CBD diameter.

CONCLUSION

In the present study, normal preoperative upper limit observed was 6.5 mm and after 4 months of cholecystectomy 50% of the patients had diameter above 6.5 mm. Mean increase in the CBD diameter was 1.67 and 1.94 mm, respectively, at 2 and 4 months after cholecystectomy. However, no patient in the present study crossed the upper limit of 10 mm. Therefore, during routine ultrasonography, an upper limit of 10 mm can be safely used as a normal physiological response of CBD to previous cholecystectomy. Age at cholecystectomy is an important factor that could affect the degree of dilatation.

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