

Original Research Article

Effectiveness of pre-operative routine MRCP in patients scheduled for laparoscopic cholecystectomy

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ABSTRACT

Background: Cholelithiasis is one of the most common surgical diseases worldwide. Laparoscopic cholecystectomy is the gold standard treatment for cholelithiasis, and has become the most common performed gastro intestinal operation. The prevalence is higher in women (7.7%) than in men (3.3%). We aimed to investigate the effectiveness of pre-routine magnetic resonance cholangiopancreatography (MRCP) before performing scheduled Laparoscopic cholecystectomy.

Methods: This was a prospective observational study conducted in the Department of General Surgery, Dhaka Central International Medical College, and selected single private Hospital from Dhaka, Bangladesh during the period from January 2021 to January 2023. In our study, we included 90 female patients presented with acute or chronic calculus cholecystitis. All patients were diagnosed with multiple gall stones diseases on USG abdomen after initial clinical evaluation were included in this study.

Result: In our study, we found the mean age was 34.97 ± 8.48 years. Among 90 patients USG showed multiple stones in 85(94.44%) patients whereas, MRCP showed stones only in 24 (26.67%) patients. Among patients with normal CBD, MRCP found 25.33 % and USG found 93.33% with stones. There were 3 patients with more than 5 mg/dl. bilirubin who was diagnosed with stones in both findings. Among the patients with 148-220 ALP levels, both USG and MRCP found 90.48% of patients with stones. We found 1 true negative case and 20 true positive cases of multiple stones (with a p value of 0.017).

Conclusion: We found that MRCP helps increase the safety of perioperative management in some cases. Preoperative ultrasonography has a low diagnostic accuracy rate when it comes to patients who also have gallstones and CBD stones. So, individuals with gallstones are advised to undergo a normal preoperative MRCP examination.

Keywords: CBD stones, Effectiveness, Laparoscopic cholecystectomy, Pre-routine MRCP

INTRODUCTION

Gallstone diseases are highly predominant in western countries where it has a prevalence of up to 15% in adults. In European nations, it is among the most frequent reasons for hospital admission due to gastrointestinal disorders.^{1,2} Additionally, gallstone disease is associated

with substantial health costs, particularly when gallstones develop symptoms or create complications.^{1,3,4} Cholelithiasis is one of the most common surgical diseases worldwide. Laparoscopic cholecystectomy is the gold standard treatment for cholelithiasis and has become the most performed gastrointestinal operation.⁵ According to a national study in 2016, cholelithiasis was

detected in 5.4% of subjects in Bangladesh. The prevalence is higher in women (7.7%) than in men (3.3%). Among them, single gall stone is 8.0% and multiple stones are 3.2%.⁶ Approximately 10% of patients with symptomatic gall stones may have associated with common bile duct stones. But, during treatment, common bile duct stones are often easily overlooked. Therefore, investigating a simple method to ascertain the existence of related CBD stones before surgery has significant clinical implications. Choledocholithiasis with potential complications including post-operative biliary leakage, recurrent biliary colic, cholangitis, and pancreatitis add further to the burden of management of gallstone diseases.⁷ But for preoperative detection of common bile duct stones and anatomical abnormality, ultrasound abdomen has limited sensitivity varying from 40%- 80% as per various studies.^{8,9} The ultrasound abdomen is a routine initial diagnostic investigation with a specificity of 100% in detecting gallbladder stones. It became the accepted gold standard in the early 1990s when meta-analyses demonstrated its superior sensitivity over computerized tomography (CT).^{10,11} So, this can lead to missed CBD stones and anatomical variation if an ultrasound abdomen is the only preoperative investigation, then post-cholecystectomy retained CBD stones, per operative bile duct injury (BTI) must increase morbidity and mortality of patients. As reported by studies, the prevalence of remaining CBD stones following a cholecystectomy range from 0.5% to 2.8%. The actual incidence of retained CBD stones may be higher as most cases remain asymptomatic for years. The median time reported for patients to present with common bile duct stones after cholecystectomy is 4 years.^{12,13} In a retrospective review of 358 patients with biliary pancreatitis and acute cholangitis, found that 100 (27.9%) patients were post-cholecystectomy only with a median reporting time of 210 days after surgery. All these patients had CBD stones that were not diagnosed at the time of surgery, thus significantly increasing the morbidity and mortality of the patients. Therefore, we need an investigation with higher accuracy in diagnosing CBD stones than an ultrasound abdomen.

Thus, choledocholithiasis cannot be accurately diagnosed by ultrasonography or other traditional procedures. Among the various studies, we select CECT abdomen, endoscopic retrograde cholangiopancreatography (ERCP), magnetic resonance cholangiopancreatography (MRCP), and intraoperative cholangiogram (IOC). ERCP and IOC are invasive procedures largely utilized for medical purposes, despite being exceedingly sensitive and specific. The sensitivity of CECT Abdomen for choledocholithiasis is less than 75%, even under ideal conditions.¹⁴ MRCP has shown a sensitivity and specificity of 95% and 98%, respectively, in the diagnosis of choledocholithiasis, which is comparable to that of ERCP and IOC.^{15,16} Several studies were also done to assess the importance of pre-operative MRCP in reducing the risk of per operative BTI, missed CBD stone, and its post-operative complications. However, the role of

routine use of pre-operative MRCP is still a matter of debate.^{17,18} Also, patients with gallstones can be evaluated by biochemical serum analysis (bilirubin, alkaline phosphatase, etc.) as part of routine preoperative screening for CBD stones.¹⁹⁻²¹ Nonetheless, the evidence indicates that increased liver enzymes do not have a high diagnostic sensitivity or accuracy for choledocholithiasis.^{20,21} Acute short-term liver cell death can impact the diagnosis of choledocholithiasis. It can induce an abnormal elevation of related predictors because of liver disease, intrahepatic bile duct stones, and various inflammatory reasons.^{19,21,22} Moreover, many studies have indicated that the accuracy of ultrasound in the diagnosis of choledocholithiasis is not high.²³⁻²⁶

Even if the ultrasound results are normal, choledocholithiasis cannot be ruled out when the specific hepatobiliary markers assessed in serum biochemical testing are abnormal. In particular, the accuracy of ultrasound generally ranges from 55-65 %.²³⁻²⁶ ERCP and IOC are invasive and cost-effective investigations. So generally, it is not a preferred option. This is not easily available in all general hospitals in our country but it can be only available in tertiary and specialized Hospital. As compared to this investigation MRCP is comparatively cheap, non-invasive, and easily available in most of the Hospitals in our country. In comparison, magnetic resonance cholangiopancreatography (MRCP) is a highly sensitive modality for detecting choledocholithiasis as well as cholelithiasis and anatomical abnormality in gallbladder and CBD. Furthermore, even in cases where the intra- and extrahepatic bile ducts are not dilated, MRCP can produce excellent cross-sectional and projection images of the bile ducts as well as depict their anatomical features. As a result, MRCP may lessen the need for treatment in cases of choledocholithiasis, as well as the associated risks of complications and bile duct injury.^{27,28} This advantage may be associated with the significant increase in preoperative routine MRCP in patients with planned cholecystectomy. On the other hand, the incidence of BTI is rare but one of the life-threatening complications that has been noticed per operatively ranging from 0.3%-0.7%.²⁹ Several factors are also associated with an increased risk of BTI due to acute or chronic inflammation, cirrhosis, previous abdominal surgery with adhesions around the hepatoduodenal ligament, and bleeding in the surgical field. Importantly, anatomical abnormalities and variations can also be exposed to BTI. Indeed, their existence can lead to misidentification of biliary anatomy or to intraoperative lesions of biliary structures that can also be misdiagnosed exposing thus the patient to postoperative complications.^{29,30} Nevertheless, magnetic resonance cholangiopancreatography (MRCP) showed high accuracy in the diagnosis of choledocholithiasis. Therefore, in this study, we aimed to investigate the effectiveness and the necessity of pre-routine MRCP before performing scheduled laparoscopic cholecystectomy.

METHODS

This was a prospective observational study conducted in the Department of General Surgery, Dhaka Central International Medical College, and selected single private hospitals from Dhaka, Bangladesh during the period from January 2021 to January 2023. In our study, we included 90 female patients presented with acute or chronic calculus cholecystitis. All patients who were diagnosed with multiple gallstone diseases on the USG abdomen after initial clinical evaluation were included in this study. These are the following criteria to be eligible for enrolment as our study participants:

Inclusion criteria

USG abdomen report showing gallstone diseases and patient willing for MRCP. Patient selected for elective laparoscopic cholecystectomy. Patients who are tested for two biochemical predictors i.e., ALP and S. bilirubin preoperatively.

Exclusion criteria

Ultrasound abdomen report showing choledocholithiasis. Previous history of biliary tract surgery. Any patient with symptoms suggesting obstructive jaundice, pancreatitis, and cholangitis. Patients with a pacemaker or any electromagnetic device implantation were investigated with ultrasound abdomen, LFT, and MRCP, and the results were evaluated. Patients with cholelithiasis underwent laparoscopic cholecystectomy, and patients with choledocholithiasis underwent ERCP followed by laparoscopic cholecystectomy. Findings of MRCP were confirmed at the time of ERCP. Patients underwent surgery, RT or CT in the department of surgery, G.R. Medical College and J.A. Group of Hospital Gwalior and Cancer Hospital and Research Institute Gwalior, (CHRJ, Gwalior) during the year January 2001 to 2006. The patients were investigated and treated according to the protocols.

Study procedures

This process was carried out by using a questioner where only female patients selected who were attending surgery outpatient department. All laparoscopic cholecystectomies were done by single consultant general surgeon specialized in laparoscopic surgery. Any patient with symptoms suggesting common bile duct stone was excluded (pancreatitis, cholangitis, and obstructive jaundice). Also, patients who had any contraindication to

MRCP examination (i.e., pacemaker, electromagnetic device or morbidly obese) were excluded. Their age ranges from 20-55 years with mean age of 34.97 ± 8.48 years. We obtained informed written consent from all patients prior to the study. All patients were subjected to full history taking, general and abdominal examination. Abdominal U/S, two biochemical parameters (including serum bilirubin, and alkaline phosphatase), MRCP were performed. All MRCP examinations were performed one week before surgery. Imaging findings from USG and MRCP were reviewed and compared by experienced radiologists. Intraoperative findings, including the presence of CBD stones and any additional surgical interventions required, were recorded. Data analysis was conducted to compare the diagnostic accuracy, clinical impact, and cost-effectiveness of pre-operative MRCP versus USG in the management of gallstone disease.

Statistical analysis

All data were recorded systematically in preformed data collection form. Quantitative data was expressed as mean and standard deviation and qualitative data was expressed as frequency distribution and percentage. Sensitivity, specificity, logistic regression analysis and Pearson correlation were done to find the significance value. Statistical analysis was performed by using SPSS 21 (Statistical Package for Social Sciences) for Windows version 10. A probability value <0.05 was considered as a level of significance. The study was approved by the Ethical Review Committee of Dhaka Central International Medical College, Dhaka, Bangladesh.

RESULTS

In this study, we enrolled ninety female patients who were diagnosed with multiple gallstones by ultrasonogram findings.

Table 1 showed that most of the patients 40 (44.44%) of multiple gallstones were aged 31-40 years. The mean age was 34.97 ± 8.48 years. The majority 40 (44.44%) of our gallstone patients were overweight and had BMI ≥ 25.0 kg/m². Among all patients with multiple gallstones, the highest number 42 (46.67%) of patients used S/C as a contraceptive method. In table 2, CBD was considered dilated ranges from 9.5 to 11 mm. S. bilirubin were considered normal ≤ 1.2 mg/dl and ALP was considered normal ≤ 147 IU/l. Table 2 shows that CBD diameter was normal in 75 patients and elevated in 15 patients. Among normal and elevated patients, CBD stone was present in 20 and 5 patients respectively. Both bilirubin and ALP was normal in 54 patients and elevated in 36 patients.

Table 1: Distribution of study patients by age, BMI and contraceptive pills.

Variables	N	%	P value
Age (in years)			
21-30	30	33.33	
31-40	40	44.44	

Continued.

Variables	N	%	P value
41-50	12	13.33	
>50	8	8.89	
Mean age (years)	34.97±8.48		0.064
BMI (kg/m²)			
<18.5 (underweight)	1	1.11	
18.5-24.9 (normal weight)	24	26.67	
≥25.0 (overweight)	40	44.44	
≥30.0 (obesity)	25	27.78	
Mean BMI (kg/m ²)	26.60±3.75		0.395
Contraceptive method			
OCP	32	35.56	
S/C	42	46.67	
Barrier/cut	6	6.67	
NIL	10	11.11	

Table 2: MRCP findings based on dilated CBD, S. bilirubin and ALP (n=90).

Parameter (mean±SD)	Value Normal / Elevated	CBD stone present in Normal / Elevated	CBD stone absent in Normal / Elevated	P value
CBD diameter (7.47±1.29 mm)	75/15	20/5	55/10	0.137
Total Serum bilirubin (1.71±1.43 mg/dl)	54/36	0/24	54/12	0.150
S. Alkaline phosphatase (129.18±75.21 IU/l)	54/36	0/24	54/12	0.503

Table 3: Accuracy of various investigations in diagnosing common bile duct stones.

Investigation	Positive predictive value	Negative predictive value	Sensitivity	Specificity
MRCP	100%	100%	100%	100%
Total Serum bilirubin	22.7%	58.3%	41.7%	77.3%
S. Alkaline phosphatase	22.7%	58.3%	41.7%	77.3%

Table 4: Univariate logistic regression analysis of the indicators.

No.	Indicator	Odds ratio (OR)	Wald value	P value
1	Age	1.006 (0.953,1.062)	0.048	0.827
2	BMI	0.996 (0.880,1.126)	0.005	0.944
3	Alkaline phosphatase	1.001 (0.995,1.007)	0.117	0.733
4	Serum bilirubin	0.954 (0.682,1.333)	0.077	0.781
5	CBD diameter	0.842 (0.571,1.241)	0.755	0.385

Table 5: Correlation analysis of the indicators.

	Age	BMI	Alkaline phosphatase	Serum bilirubin	CBD diameter
Age					
BMI	0.327**(0.002)				
Alkaline phosphatase	0.189 (0.074)	0.196 (0.064)			
Serum bilirubin	0.314** (0.003)	0.235* (0.026)	0.741** (0.000)		
CBD diameter	0.225* (0.033)	0.201 (0.057)	0.705** (0.000)	0.881** (0.000)	

** indicates Correlation is significant at the 0.01 level (2-tailed); * indicates Correlation is significant at the 0.05 level (2-tailed).

Among normal patients, there was no presence of CBD stone. Table 3 shows that sensitivity and specificity of MRCP was 100%. The sensitivity & specificity of both serum bilirubin and ALP was 41.7% and 77.3% respectively. Table 4 presents the results of a univariate logistic regression analysis, examining the association between various indicators and the outcome. Based on the research, the odds ratio (OR) of age was 1.006 (95% CI: 0.953-1.062), and p value of 0.827. Additionally, BMI was indicated by an OR of 0.996 (95% CI: 0.880-1.126) with a p value of 0.944. Serum bilirubin has an OR of 0.954 (95% CI: 0.682-1.333) with a p value of 0.781, whereas alkaline phosphatase has an OR of 1.001 (95% CI: 0.995-1.007) with a p value of 0.733. Lastly, the common bile duct (CBD) diameter shows no significant analysis with an OR of 0.842 (95% CI: 0.571-1.241) and a p value of 0.385. Table 5 shows the correlation analysis of the indicators. This analysis showed that $p > 0.05$ for all indicators, and the correlation coefficient < 0.20 , indicating no significant correlation. Among all these indicators, there is a positive and significant correlation between alkaline phosphatase, serum bilirubin and CBD diameter.

DISCUSSION

The diagnosis and treatment of cholelithiasis, a frequent condition that necessitates general surgery, have gradually advanced due to the rapid advancement of medical technology. However, there is currently no recognized technique for diagnosing cholelithiasis due to the complexity of the biliary system. To determine the validity of routine MRCP and the accuracy of ultrasound in diagnosing concurrent gallstones and choledocholithiasis, data regarding individuals with these conditions was gathered and examined in this study. Among 90 patients USG showed multiple stones in all patients whereas, MRCP showed CBD stones only in 25 (27.78%) patients.

In a retrospective investigation of 413 gallstone patients who had both MRCP and ultrasonography exams, Qiu et al. discovered that 109 cases (26.39%) of all cases had both gallstones and choledocholithiasis at the same time. Of these, 60 cases of choledocholithiasis were found by ultrasonography, with a detection rate of 55.05%. The other 49 cases of choledocholithiasis did not show up on ultrasonography, with a 44.95 percent ultrasound missed diagnostic rate. The aforementioned conclusion implies that three indicators, namely alanine aminotransferase, acute cholecystitis, and CBD diameter, were significantly different between the two groups and that ultrasound is not a trustworthy approach for the preoperative screening of CBD stones. Specifically, the correlation analysis between these three indicators and the primary variable "ultrasound missed diagnosis of CBD stones" revealed that the primary variable had a negative correlation with CBD diameter and a positive correlation with alanine aminotransferase and acute cholecystitis.

Many investigations have shown the connection between CBD stones and acute cholecystitis; these reports also frequently indicate that acute cholecystitis is a major clinical manifestation of choledocholithiasis. Tsai et al reported that acute cholecystitis is one of the severe concurrent complications of the recurrence of choledocholithiasis after treatment.³² Boys et al reported that the diagnosis of CBD stones in the case of choledocholithiasis associated with acute cholecystitis is unreliable based on the CBD diameter by ultrasound.³³ The rapid development of acute cholecystitis can result in substantial clinical symptoms. However, the body's quick response to stress can disguise the CBD stones by causing considerable changes in certain markers' values. According to Wong et al, MRCP is the most effective technique for diagnosing acute cholecystitis linked to choledocholithiasis, while Lee et al found a correlation between the development of acute cholecystitis and the CBD diameter and bilirubin level.¹⁹ Though no correlation has been observed between acute cholecystitis and a choledocholithiasis diagnosis missed by ultrasound, it is generally accepted that there is a relationship between acute cholecystitis and choledocholithiasis.³⁴

The mechanism by which acute cholecystitis influences the ultrasound diagnosis of choledocholithiasis is still unknown, and more research is required, even if Qiu et al's statistical approaches validated the association between these variables.³¹ The correlation between CBD diameter and CBD stones, on the other hand, is more evident because a higher CBD diameter is one of the main risk factors for CBD stones. However, the CBD's diameter does not appear to be positively connected with the incidence of CBD stones, according to several studies.^{32,33}

In our study, we found the positive predictive value of MRCP was 100%. Rao GB et al did MRCP for all cases the positive predictive value was 100% but MRCP for the suspected CBD stone case (after LFT and USG abdomen) was only for 17 cases (15/17 cases).³⁵ In this study, the sensitivity and specificity of MRCP was 100%. Gurpreet Mann et al found similar findings to ours.³⁶ Before undergoing a cholecystectomy, Nebiker et al used magnetic resonance cholangiopancreatography (MRCP) to examine the bile ducts. They concluded that, despite MRCP's occasional diagnostic value in perioperative care, the costs associated with routine use of the procedure in the DRG era may outweigh the benefits.¹⁸ Therefore, routine preoperative MRCP screening is recommended for patients with gallstones to rule out any simultaneous CBD stones. Yan Qiu et al. concluded that preoperative ultrasonography does not have good diagnostic accuracy for the identification of related CBD stones for patients with gallstones.³¹ The switch from open to laparoscopic cholecystectomy as a surgical procedure has resulted in an increased incidence of iatrogenic bile duct injury, which has been reported to be more than 2.6 times the previous rate. It has also increased from 0.1% to 0.5% to 3% when compared to

open cholecystectomy.³⁷ Any severe damage to the bile duct may cause the patient to have substantial morbidity, a higher risk of death, and financial hardship.³⁸ As a result, it is crucial to prevent bile duct damage, and surgeons must comprehend the architecture of the bile duct before doing any surgery.³⁹ In our institute, MRCP was first limited to cases where cholangitis was suspected based on laboratory results or when the results of CT or ultrasonography were inconclusive in the diagnosis of choledocholithiasis. However, preoperative MRCP has been used in the majority of cholecystectomy patients during the past two years to both discover silent stones and prevent damage to the bile ducts. The financial implications of routinely performing MRCP before laparoscopic cholecystectomy have generated controversy. Previous studies have shown that standard preoperative MRCP was not a cost-effective way to diagnose and treat asymptomatic choledocholithiasis associated with gallstone disease.⁴⁰ Nonetheless, we think that in some situations, MRCP is required and can be very helpful in diagnosing patients and treating them, both of which can improve patient outcomes. To the best of our knowledge, however, no research has been done to determine whether pre-routine MRCP is required for individuals who are scheduled for laparoscopic cholecystectomy. Consequently, more thorough research would be required to determine the criteria for choosing patients for preoperative MRCP to find silent CBD stones.

Limitations of the study was that it was multiple-centre study. We took a small sample size due to our short study period. We did not evaluate the treatment for GB disease (cholecystectomy or medications) among patients. We did not classify ultrasonographic findings for GB disease like cholesterol stone, pigment stone, polyp, etc. After evaluating those patients, we did not follow up with them for the long term and do not know other possible interference that may happen in the long term with these patients.

CONCLUSION

In our study, we found that MRCP is helpful to increase the safety of perioperative management in some cases. Preoperative ultrasonography has a low diagnostic accuracy rate when it comes to patients who also have gallstones and CBD stones. Specifically, high levels of alanine aminotransferase, acute cholecystitis, and almost normal CBD diameters were found to be important variables that could influence the diagnosis's precision. To rule out the possibility of concurrent CBD stones, individuals with gallstones are advised to undergo a normal preoperative MRCP examination. So further study with a prospective and longitudinal study design including a larger sample size needs to be done to determine the necessity of MRCP and also validate the findings of our study.

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