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Prediction of Difficulty of Laparoscopic Cholecystectomy by Preoperative Ultrasonography: A Randomized Control Trial

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Abstract

The aim of this study was to determine whether the preoperative USG finding can predict the difficulty during the laparoscopic cholecystectomy and its conversion. 500 patients undergoing Laparoscopic cholecystectomy at Sawai Mansingh Medical College and attached Hospital were included. Sonographic parameters like Gall Bladder wall thickness, antero posterior diameter of Gall Bladder in fasting state, impacted gall stone, CBD diameter were taken into consideration and difficulties in terms of time taken for surgery, cystic duct injury; cystic artery injury and lead to conversion were analyzed. Of the 400 cases, 24 (6.0

Index terms— gall bladder, cholelithiasis, ultrasonography, laparoscopy, cholecystectomy

1 Introduction

ouret performed the first laparoscopic cholecystectomy (LC) in 1987 in France. Now for symptomatic cholelithiasis LC is considered as GOLD STANDARD surgery. Cost effectiveness, quick recovery and consumer satisfaction (patient acceptance) are the major criteria for the procedure of choice for any disease. Though set up and instrument are more expensive for LC, but earlier return to work and the shorter hospital stay make the procedure more cost effective. [1][2][3][4] Patient satisfaction is indeed higher with LC. Thus performance of LC enables hospitals to treat more patients of gall stone disease at a lower cost, with better patient satisfaction as compared to OC. Many centers now perform LC as a day care operation and almost all centers discharge patients on the first post-operative day. Difficulty faced during operation may require relative or emergency conversion to open procedure or aspect of planning laparoscopic surgery. With the help of accurate prediction, high risk patients may be informed beforehand and they may have a chance to make arrangements regarding their professional and family commitments. The surgeons also may have to schedule the time and the team for the operation appropriately. Patients predicted to have a high risk of conversion or difficulties in operation have to be operated on by an experienced team these patients are not suitable for resident training. When operating on a high risk patient there should be a low threshold for conversion, because early conversion shortens the operating times and decreases morbidity. [6][7][8][9] Patient selection is very important for day care procedures, and low risk patients have to be selected ??5,11,12 Patients predicted to have high risk have to be scheduled for longer hospitalization and more intensive facilities. Hospitals have to plan admissions and bed vacancy accordingly. Ultrasonography is the most common screening test for cholecystitis and cholelithiasis. It is easy, non invasive, safe and a highly accurate imaging technique. It detects gallstones with accuracy of more than 95%. Several studies have been carried out to assess the risk of conversion preoperatively. Kama et al conducted retrospective study. ??0 Many studies have found thickened gall bladder wall in USG to be an accurate predictor of difficulties that might be faced during LC. ??0, ??1, ??2 This is despite the fact that ultrasound is a highly observer dependent investigation. While most of the previous studies in the literature were retrospective and evaluated various risk factors in terms of conversion to OC, our is a prospective study analyzing these risk factors as preoperative predictors on USG not only for conversion of LC to OC but also for anticipating difficulties in LC. All patients included in the study underwent detailed history taking and clinical examination. All routine investigations including liver function test and coagulation profile were done. Pre-operative ultrasound was done for all patients and following criteria

were assessed :-Gall Bladder wall thickness-more than or less than 3 mm, Antero Posterior Gall Bladder diameter in fasting state-less than 3 cm and more than 5 cm, Impacted gall stones, CBD diameter-more than or less than 6 mm.

2 II.

3 Materials and Methods

The selected patients were then told about the procedure and written informed consent was taken. Patients were also informed about the conversion to open cholecystectomy.

Standard four port technique with patient in American position was used for laparoscopic cholecystectomy. Intra-operatively following criteria's were assessed: -Duration of surgery from the insertion of Veress needle to the extraction of gallbladder more than or less than 90 minutes, Spillage of bile and stone present or not, injury to duct, cystic artery and any other complication during surgery. Procedure was defined as easy or difficult based on following criteria: Easy and difficult criteria Reasons for conversion:-Difficult dissection (adhesions at Calot's triangle), Unclear anatomy (short cystic duct, dilated cystic duct), Injury to biliary tract or other viscera, Bleeding during dissection.

4 III.

5 Results

The study was conducted in a total of 400 patient's age between 17 to 75 years. After proper evaluation and assessment, all patients were planned for laparoscopic cholecystectomy. The female to male ratio was 2.6: 1. The above sex distribution shows that the gall bladder diseases have a higher frequency in females than in males in all age groups.

6 c) Gall bladder wall thickness

The maximum gall bladder wall thickness was found to be 6mm and minimum 1.6mm with mean thickness 2.4mm. There were 156 (39%) patients with gall bladder wall thickness more than 3mm.

7 d)

There were 144 patients (36%) with contracted/distended GB. The remaining 256 patients had gallbladder of normal volume.

8 e) Stone impacted at the neck of Gall bladder

There were 88(22%) patients with gall stone impacted at the neck of gall bladder or Hartman's pouch. The rest of the 312 patients had mobile gall stones. The patients with gall bladder full of stones with no mobility of the stones due to gallbladder being totally packed with stones was taken as stone impacted at the neck of gall bladder.

9 f) Common bile duct dilatation more than 6mm

There were only 12 (3%) patients with common bile duct diameter more than 6mm. This could be due to the reason because the patients with common bile duct stones were excluded from the study.

10 g) Prediction of the difficult cases on Ultrasonography

The total number of cases predicted to be difficult on ultrasonography was 144 patients (36%).The remaining 256 cases (64%) were predicted to be easy.

11 h) Total number of difficult laparoscopic surgeries

The total number of laparoscopic cholecystectomy attempted was 400 out of which 135 (33.75%) were found to meet the difficulty criteria. The remaining 265(66.25%) cases were easy on laparoscopic cholecystectomy.

12 i) Conversion to open cholecystectomy

Out of total 400 cases 24 (6.0%) cases were converted to open procedure. In the remaining 376 cases the laparoscopic cholecystectomy was completed successfully (including the difficult cases which were not converted to open cholecystectomy). The various reasons for conversion were 20 (5.0%) cases due to dense adhesions in the calot's triangle, and gallbladder with the surrounding viscera that is colon and omentum and bleeding due to tear of cystic a) Age Distribution

The age group of the patients ranged from 17 to 75 years with mean age 40 years. The maximum artery, 3 (0.75%) cases due to gangrenous GB one case (0.25%) due to cholecysto-colic fistula. IV.

13 Discusion

LC is the procedure of choice for symptomatic cholelithiasis. [16][17][18] The most common reasons for difficulty during LC are severe inflammation, dense adhesions and bleeding. 6 Severe inflammation and high vascularity as in the case of acute cholecystitis, lead to difficulty in defining the anatomy of Calot's triangle and is associated with increased risk of bleeding. Besides this, impacted stone at the neck may be associated with difficulty in gripping the inflamed and friable gallbladder. Dense adhesions also make it difficult to define the anatomy of the Calot's triangle. Separation of a gall Similarly, prediction of difficult laparoscopic cholecystectomy preoperatively leads to better preparation on behalf of surgeon for a challenging procedure and chances of conversion. Early conversion in such patients is proved to decrease postoperative morbidity. 1,6,8 Difficult operation can also be scheduled early in the operation theatre day. Such patients should be operated by more experienced surgical team. Also surgeons in the early phase of their learning curve should refer such patients to more experienced centers.

Several studies have been done to asses predictive factors for conversion of LC to OC. Our study has assessed risk factors for difficulty in LC also. Conversion has been included as one of the criteria for difficulty. In most previous studies adhesions, unclear anatomy and bleeding have been found to be the major factors necessitating conversion to OC. In their study of 628 patients posted for elective LC, Sanabaria et al, had to convert 32 patients to OC. 6 In our study, dense adhesions causing problems in dissection, defining anatomy, spillage of bile and stone and bleeding have been taken as criteria for difficulty. In addition increased operating time and conversion have been taken as criteria for difficult LC.

Daradkeh et al studied the overall difficulty scores (ODS) of LC. 14 and found that "gall bladder wall thickness and CBD diameter were found to be significant predictors of ODS." Some studies found distended gall bladder as the major predictor of conversion while others have implicated a contracted gall bladder. 13,15 a) Gall bladder wall thickness In our study, thickened gall bladder wall was found to be a significant predictor of difficulty in LC ($p<0.001$). Thickened gall bladder wall was significantly associated with adhesions ($p<0.002$), bleeding ($p<0.0001$), and increased operating time ($p<0.0001$). Out of 24 patients who were converted, 16 have thickened GB wall. According to Fried et al patients with thickened gall bladder wall have 8 times more chances of conversion to OC. 5 They have associated a thickened gall bladder wall with difficulties in exposure of biliary anatomy. "These factors contributed to difficulties in retraction and increased chances of liver tears and bleeding from gallbladder bed, thus causing increased bleeding in these patients. A consequent increase in operating time was also noticed." b) Gall bladder diameter Gall bladder size also predicted difficult LC in our study. Gall bladder transverse diameter was found to be significant as a predictor of a difficult LC ($p=0.0060$). This is in accordance to Velden et al contracted gall bladder on ultrasound examination (after overnight fasting) is associated with adhesions, problems of exposure and difficulty in separation of gall bladder from the liver. In a study conducted by Lal et al, contracted gall bladder was found to be one of the predictors for conversion of LC to OC. 13 Many others have identified a contracted gall bladder as a potential factor for conversion. **??**0,19,20,21 In our study only increased operative time ($p=0.0042$) and adhesions ($p=0.0086$) were found to be significantly associated with GB transverse diameter. Bleeding ($p =0.0710$) were found to be statistically insignificant.

14 c) Impacted stone in GB

In our study impacted stone and certain complications have correlation, so this is a good predictor of conversion to the open procedure, which is contrary to the findings in other studies in which stone impaction is shown to have a moderate correlation. 1,9 The main difficulty with stone impacted at the neck or Hartman's pouch is that it hinders holding of the gallbladder during dissection, and also due to impacted stone, the gallbladder is distended with mucus forming the mucocele of the gallbladder, which is even more difficult to hold from the fundus. In our study only increased operative time was found to be significantly associated with GB transverse diameter with $p = 0.0035$. Presence of adhesions ($p=0.345$) and bleeding ($p =0.810$) were found to be statistically insignificant.

15 d) CBD diameter

Out of the four ultrasonic parameters studied common bile duct diameter more than 6mm, the number of cases in our study was not enough to give a significant statistical value. This is due to the reason that the patients with common bile duct stones were not included in the study.

16 e) Conversion

In our study 24 patients required conversion to open cholecystectomy. Thus a conversion rate of 6% was observed. This is in accordance with the conversion rates observed in most recent series (3 to 5%). 5, **??**0,14 Reasons for conversion in the 20 patients were dense adhesions and bleeding due to injury to cystic artery. In these patients had thickened gall bladder wall, impacted stone and abnormal GB diameter. The 3 cases were converted due to presence of gangrenous GB one case due to cholecysto-colic fistula.

Though, GB transverse diameter and thickened gall bladder wall and impacted stones in GB on preoperative ultrasound were found significant in univariate analysis, multivariate analysis concluded that only thickened gall bladder wall and GB transverse findings. 15 Their study however, was a retrospective study. Difficulties were encountered when a distended gall bladder was associated with a large stone impacted diameter were significant

factors in prediction of a difficult LC and conversion to open. USG is most useful in providing accurate information on several parameters like gall bladder wall thickness, gall bladder size, CBD diameter and CBD stones, impacted stones and any anatomical variations of the biliary tract. Thick gall bladder wall is a finding which may show that more adhesions may be found during surgery. Common bile duct dilatation may give an idea about the possibility of common bile duct stones. The impaction of stone at the neck of gallbladder followed by the gallbladder wall thickness and contracted gallbladder were the most accurate predictors of the potential operative difficulty and conversion to open procedure. Thus a careful preoperative USG by an experienced radiologist using state of the art instrument is indispensible while planning a laparoscopic cholecystectomy.

Figure 1:

2

Table1 : Correlation of ultrasonographic prediction and difficulty in performing laparoscopic cholecystectom
conversion to open procedure (Table 1)

Sensitivity of ultrasonographic prediction = 85.92%
Specificity of ultrasonographic prediction = 89.43%
Positive predictive value (of cases to be difficult on ultrasonography) = 80.55%
Negative predictive value (of cases to be easy on ultrasonography) = 92.57%
Percentage of false negative = 14.07%
Percentage of false positive tests = 10.56%

Sensitivity of ultrasound to predict the conversion
open procedure was = 75%.
Specificity = 66.48%,
Positive predictive value = 12.5%.
Negative predictive value = 97.65%
Percentage of false negative was = 33.33%.
Percentage of false positive tests was =33.51%

N	No of cases difficult on surgery	No of cases easyon surgery	No of cases converted to open surgery	No of cases not converted to open surgery	
NO of cases with GB wall thickness > 3mm	102	54	16	140	156
NO of cases with GB wall thickness < 3mm	33	211	08	236	292
Total	135	265	24	376	400

Sensitivity of gall bladder wall thickness to predict difficulty in laparoscopic surgery was 75.55%,
Specificity 79.62%,
Positive predictive value 65.38%,
Negative predictive value 86.47%

Sensitivity of gallbladder wall thickness to predict conversion to open cholecystectomy was 66.66%,
Specificity 62.76%,
Positive predictive value 10.25%,
Negative predictive value 96.72%

Figure 2: Table 2 :

3

(Table 3)

	No of cases difficult on surgery	No of cases easy surgery	No of cases converted to open surgery	No of cases not converted to open surgery	Total
No of cases with contracted and distended GB	98	46	14	130	144
No of cases without contracted and distended GB	37	219	10	246	256

Figure 3: Table 3 :

4

cholecystectomy and conversion to open surgery (Table 4)

	N No of cases difficult on surgery	No of cases easy on surgery	No of cases converted to open surgery	No of cases not converted to open surgery	Total
No of cases with impaction of stone at neck of GB	50	38	13	75	88
No of cases without impaction of stone at neck of GB	85	227	11	301	312
Total	135	265	24	376	400

Sensitivity of stone impaction at the neck of gall bladder to predict difficult laparoscopic cholecystectomy was 37.03%,
Specificity 85.66%,
Positive predictive value 56.81%,
Negative predictive value 72.75 and

Sensitivity of the impaction of stone at the neck bladder and conversion to open cholecystectomy 54.16%,
Specificity 80.05%,
Positive predictive value 14.77%,
Negative predictive value 96.47%.

Figure 4: Table 4 :

5

conversion to open surgery (Table 5)

USG parameter	Difficult/ open	Sensitivity	Specificity	PPV	NPV
Combined	Difficult	85.92	89.43	80.55	92.57
	Open	75	66.48	12.5	97.65
Wall thickness	Difficult	75.55	79.62	65.38	86.47
	Open	66.66	62.76	10.25	96.72
Contracted GB	Difficult	72.59	82.64	68.55	85.54
	Open	58.33	65.42	9.72	96.09
Impacted stone	Difficult	37.03	85.66	56.81	72.75
	Open	54.16	80.05	14.77	96.47

Figure 5: Table 5 :

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