

## AN OBSERVATIONAL STUDY ON PREDICTION OF DIFFICULTIES DURING LAPROSCOPIC CHOLECYSTECTOMY IN CASES OF CHOLELITHIASIS BY PREOPERATIVE ULTRASONOGRAPHY

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### Abstract

Laparoscopic cholecystectomy has become the treatment of choice for cholelithiasis. Some reliable factors are needed to predict difficulties during laparoscopic cholecystectomy. So, our aim was to study various preoperative ultrasonographic parameters which may predict difficulties in performing laparoscopic cholecystectomy.

One twenty five patients of cholelithiasis admitted for elective laparoscopic cholecystectomy were studied. Pre-operative ultrasonographic parameters such as gall bladder(GB) wall thickness, transverse diameter of GB, pericholecystic fluid collection, gall stone mobility, number of stones & size of largest stone, common bile duct (CBD) diameter and emphysematous cholecystitis were given a score of 0 or 1 based on findings being negative or positive respectively. Total score was correlated with the difficulties faced during laparoscopic cholecystectomy.

Out of 125 cases, 42(33.6%) cases were found to be difficult during laparoscopic cholecystectomy and 6 cases (4.8%) required conversion to open cholecystectomy. GB wall thickness (p value= 0.00001), transverse diameter of GB (p value= 0.001), pericholecystic fluid collection (p value= 0.00001), dilated CBD (p value=0.007), size of stone (p value= 0.007) found to be statistically significant in predicting difficulties during laparoscopic cholecystectomy. Higher the preoperative USG score, higher were the chances of difficult laparoscopic cholecystectomy and conversion to open cholecystectomy.

In conclusion; Pre operative ultrasonography in the form of a formulated score is a good predictor of difficulties during laparoscopic cholecystectomy.

**Keywords:** preoperative ultrasonography, difficult laparoscopic cholecystectomy, conversion.

### Introduction

Within a short span of merely two decades since its introduction, laparoscopic cholecystectomy has become widely accepted as the procedure of choice for symptomatic gall bladder disease.

With their growing experience in this surgery, the surgeons have started taking up more complex cases and high risk patients, some of which considered relative contraindications a couple of years back. Thus, with wider application of laparoscopy for technically difficult and high risk patients, it was expected that complication rates would rise as also the rate of conversion to open cholecystectomy. Although 2% to 15% patients require conversion to open cholecystectomy for various reasons

but irrespective of this morbidity and mortality, statistics do still favor laparoscopic over open approach. We have tried to look at various factors and conditions that would help a surgeon to predict a “difficult cholecystectomy”.

Preoperative prediction of a difficult laparoscopic cholecystectomy not only helps in counselling the patient but also help the surgeon to prepare better for intraoperative difficulties expected to be encountered. Moreover, the patient safety may further be improved by involving an experienced surgeon both preoperatively in decision making and also during the surgery.

Abdominal ultrasound which is performed in majority of cases has become a reliable, quick and

non invasive tool to diagnose gall stone disease <sup>1</sup>. Apart from its value in establishing the diagnosis, it may also predict the degree of difficulty involved in the procedure. Factors which can be considered are gall bladder wall thickness, AP diameter of the gall bladder, impacted stone at the neck, number of stones, pericholecystic fluid collection and size of the CBD. One of the most important finding is maximal gall bladder wall thickness of more than 3.0 mm which indicates a contracted fibrotic gall bladder which is difficult to grasp <sup>2</sup>. Apart from this, the ultrasound may demonstrate a porcelain gall bladder, calcification of gall bladder wall and a gall bladder containing large stone; all of these lead to technical difficulties due to inability to grasp and retract with standard laparoscopic instruments. Although a meta-analysis of diagnostic characteristics of ultrasonography published in 1994 has revealed a sensitivity and specificity of 94% and 78% respectively.

Hence, this study was conducted to evaluate the various risk factors on preoperative ultrasound which can predict difficulties during laparoscopic cholecystectomy so that proper preoperative planning can be done.

### Aim of study

Evaluation of pre operative ultrasound findings in predicting difficulties during laparoscopic cholecystectomy for cholelithiasis.

### Objective

To predict potential difficulty to be faced during laparoscopic cholecystectomy so that proper preoperative planning & counselling can be done to reduce overall complications & mortality.

### Patients and Methods

**STUDY DESIGN:** This study was hospital based analytic type of observational study, conducted in the general surgery department of SMS Hospital & attached group of hospitals, Jaipur from May 2019 to October 2020. Permission was obtained from ethics committee and scientific advisory committee of the institution.

**SAMPLE SIZE COLLECTION:** Sample size was calculated at 95% confidence level & 80% study power assuming 94.3% sensitivity of ultrasonography to assess difficult lap cholecystectomy & 35% prevalence of difficult lap cholecystectomy

among cholelithiasis cases undergoing lap cholecystectomy. Minimum sample size required was 105 patients of cholelithiasis which was further rounded off & enhanced to 125 such patients.

**INCLUSION & EXCLUSION CRITERIA:** Patients of either sex admitted in the general surgery department with diagnosis of calculous cholecystitis and willing to participate in the study were included.

Patients having concomitant CBD stone, comorbid conditions like uncontrolled diabetes mellitus, uncontrolled hypertension, coagulopathies, severe cardiac failure, pregnant patients and patients unfit for general anaesthesia were excluded from the study.

### STUDY PROCEDURE:

- The cases of laparoscopic cholecystectomy conversion to open cholecystectomy due to equipment failure and any emergency surgery excluded from the study. After the OPD workup, following factors evaluated on ultrasonography preoperatively by the consultant radiologist posted in main USG room of SMS Hospital-

- Gall bladder wall thickness
- Antero-posterior diameter of gall bladder
- Impacted gall stone
- Size of largest stone
- Number of stones
- Pericholecystic fluid collection
- Diameter of CBD
- Emphysematous cholecystitis

- Above ultrasonographic parameters were given score of 0 or 1 based on findings being negative or positive respectively (Table1). Total score was calculated considering all eight USG parameters. Thus, a total score of a minimum of 0 and a maximum of 8 was found. Total score was correlated to intraoperative difficulty of surgery.

Surgery done using CO2 pneumoperitoneum with 15 mm hg pressure and using standard two 10mm ports & two 5mm ports. The timing noted from first port site incision till last port closure. Time taken to dissect the calot's triangle was also noted. All the intraoperative events like bleeding, injury to biliary tree or other viscera were recorded. All cases received standard postoperative care and follow up. Postoperative complications like bleeding, bile leakage or wound infection or other complications, if any were noted.

**Table (1):** Ultrasound scoring system

USG parameters		score
GB wall thickness	3mm or <3mm	0
	>3mm	1
AP diameter of GB	2-5 cm	0
	<2cm or >5cm	1
Gallstone mobility	No impaction	0
	Impacted	1
Pericholecystic fluid	No	0
	yes	1
Size of largest stone	1cm or <1cm	0
	>1cm	1
Number of stones	Single	0
	multiple	1
CBD diameter	<6mm	0
	>6mm	1
Emphysematous cholecystitis	No	0
	yes	1

All the patients to be evaluated in terms of clinical, biochemical, haematological and USG parameters. Conversion rate and reason for conversion was noted.

Reason for conversion-

- a) Difficult dissection( adhesions at calots) or frozen calot triangle
- b) Abnormal anatomy of biliary tree
- c) Injury to biliary tract or other viscera
- d) Bleeding during dissection that hindered visual field
- e) Buried or intrahepatic gall bladder

**STATISTICAL ANALYSIS:** Categorical data was presented as frequency or percentage while data on continuous variables was presented as mean ± standard deviation.

Statistical significance of difference of categorical variables was tested using chi-square test or Fisher’s exact test. Statistical significance of normally distributed continuous variables was tested using independent sample ‘t’ test and for non-parametric

data MannWhitney U test was used.

Measures of diagnostic efficacy indices such as sensitivity, specificity, positive predictive value (PPV), negative predictive value (NPV) and accuracy were calculated along with 95% CI for accuracy measure. P-values less than 0.05 were considered to be statistically significant.

**Results**

One hundred twenty five patients of cholelithiasis who underwent laparoscopic cholecystectomy were studied. Age and sex of the patients were recorded. Mean age of the patients was 42.74 ±15.47 years. Of 125 cases studied, 29 cases (23.2%) were male and 96 cases (76.8%) were female.

Mean operating time was calculated to be 44.64 minutes and standard deviation of mean operating time was calculated to be 11.47 minutes. Mean time taken to dissect calots triangle was 25.13 minutes and standard deviation was 8.59 minutes.

Of 125 laparoscopic cholecystectomies per-

formed, 42 cases (33.6%) were found to have difficulty during surgery in the form of adhesions, difficult calots dissection, spillage of bile and stones, vascular or biliary tree injury or bowel injury. Of the 42 difficult cases, 6 cases were converted to open procedure. It was seen that higher the preoperative USG score, higher were the chances of conversion to open procedure.

As depicted in Table 2, USG findings such as GB wall thickness >3mm, contracted or distended GB( AP diameter of GB <2cm or >5cm), presence of pericholecystic fluid, large stones( >10mm), dilated CBD (>6mm) were significantly associated with difficulties encountered during laparoscopic cholecystectomy.

**Table (2):** Preoperative USG findings & incidence of difficulty

USG PARAMETERS		DIFFICULT	EASY	TOTAL	P VALUE
GB WALL THICKNESS-	>3mm	33	5	38	
	≤3mm	9	78	87	0.00001
GB SIZE-	<2cm or >5cm	33	38	71	
	2-5cm	9	45	54	0.001
GALL STONE MOBILITY-	Impacted	10	11	21	
	mobile	32	72	104	0.215
SIZE OF STONE-	>1cm	31	39	70	
	≤1cm	11	44	55	0.007
NUMBER OF STONES-	Multiple	25	48	73	
	Single	17	35	52	0.991
PERICHOLECYSTIC FLUID-	Yes	28	2	30	
	No	14	81	95	0.00001
CBD DIAMETER-	>6mm	5	2	7	
	≤6mm	37	81	118	0.007
EMPHYSEMATOUS CHOLECYSTITIS-	Yes	1	0	1	
	no	41	83	124	

As shown in Table 3, GB wall thickness is the most accurate predictor for a difficult laparoscopic cholecystectomy with an accuracy of 88.8% followed by presence of pericholecystic fluid ( accuracy= 87.2%).

As shown in Table 4, There was a statistically significant difference between preoperative USG score and difficult or non difficult laparoscopic cholecystectomy ( p value=<0.00001). Higher the preoperative USG

score , higher were the percentage of difficult laparoscopic cholecystectomy.

Six cases were converted from laparoscopic procedure to open procedure and it was observed that higher the preoperative USG score , higher were the percentage of conversion to open cholecystectomy.

**Table (3):** Diagnostic accuracy of preoperative USG findings

USG PARAMETERS	SENSITIVITY	SPECIFICITY	PPV	NPV	ACCURACY
GB WALL THICKNESS (>4mm)	78.5	93.97	86.84	89.65	88.8
CONTRACTED OR DISTENDED GB	78.5	54.2	48.4	83.3	62.4
IMPACTED GALL STONE	31.25	86.75	47.62	69.23	65.6
LARGE CALCULUS	73.81	53.01	44.28	80	60
MULTIPLE GALL STONES	59.52	42.17	34.25	67.31	48
PRESENCE OF PERICHOLECYSTIC FLUID	66.66	97.59	93.33	85.26	87.2
DILATED CBD	11.90	97.59	71.42	68.64	68.8
EMPHYSEMATOUS CHOLECYSTITIS	2.38	100	100	66.93	67.2

**Table (4):** Preoperative USG score & intraoperative difficulty

USG score	Difficult cases	Easy cases	Total
0-1	3(6.97%)	40(93.02%)	43
2-3	8(17.7%)	37(82.2%)	45
>=4	31(83.78%)	6(16.21%)	37
Total	42	83	125

**Discussion**

Clear benefits of laparoscopic cholecystectomy have rendered it the procedure of choice for symptomatic cholelithiasis <sup>3-6</sup>. The advantages to the patients and the cosmetic benefits laparoscopic cholecystectomy to the society and the health care system have been well documented<sup>6</sup>.

The inherent technicalities involved in the laparoscopic procedures make laparoscopic cholecystectomy more difficult in certain patients. The most common reason for difficulty during laparoscopic cholecystectomy are dense adhesions, bleeding and severe inflammation <sup>7</sup>. Thus, aim of our study was to evaluate pre operative USG parameters which could reliably predict chances of difficulties encountered during laparoscopic cholecystectomy.

In our study, thickened gall bladder wall was found to be a significant predictor of difficulty in laparoscopic cholecystectomy (p value= 0.00001). 78.57% of the difficult patients had a thickened gall bladder wall as compared to 6.02% of the easy patients. Such patients were found to have significant more chances of having a difficult laparoscopic cholecystectomy as compared to patients without thickened gall bladder wall. According to Fried et al patients with thickened gall bladder wall have 8 times more chances of conversion to open cholecystectomy <sup>8</sup>.

Gall bladder transverse diameter was found to be a significant predictor of difficult laparoscopic cholecystectomy ( p value= 0.001). this is in accordance to Velden et al findings <sup>9</sup>. In a study of 738 patients,

Jansen et al found contracted gall bladder to be statistically significant for risk of conversion<sup>10</sup>. In a study conducted by Lal et al, contracted gall bladder on preoperative ultrasound was found to be one of the predictors for conversion of laparoscopic cholecystectomy to open cholecystectomy<sup>11</sup>.

In our study, we found pericholecystic fluid collection to be a significant predictor of difficult laparoscopic cholecystectomy (p value= 0.00001). Out of 42 difficult laparoscopic cholecystectomies, 28 had pericholecystic fluid collection on preoperative USG and also out of 30 patients having pericholecystic fluid collection on preoperative USG, 28 turned out to be difficult. In a study conducted by Nidoni et al, the sensitivity, specificity, positive predictive value and negative predictive value of pericholecystic collection in predicting conversion of laparoscopic cholecystectomy to open surgery were 70%, 91.76%, 33.33%, and 98.11% respectively as compared to 66.66%, 97.59%, 93.33% and 85.26% respectively in present study<sup>12</sup>.

In our study, impacted stone in GB was found to be significant predictor of difficult laparoscopic cholecystectomy with an accuracy of 65.6%. 31.25% of the difficult patients had a impacted stone in GB as compared to 13.25% of the easy patients. According to Fried et al, patients with impacted stone in GB have six times more chances of conversion to open cholecystectomy<sup>13</sup>.

In the present study, we also found a significant association between size of stone and difficulty during laparoscopic cholecystectomy (p value = 0.007) with an accuracy of 60%. Number of stones in GB had no significant link with difficulty during laparoscopic cholecystectomy (p value= 0.991). Jansen et al stated that stone size more than 20mm was associated with increased risk of conversion<sup>14</sup>.

In our study, dilated CBD (>6mm) was found to be significantly associated with difficult laparoscopic cholecystectomy (p value= 0.007) with an accuracy of 68.8%. Out of seven patients having dilated CBD on preoperative USG, 5 encountered difficulties during laparoscopic cholecystectomy. Dilated CBD was associated with adhesions, bleeding and increased operating time. According to Shendier et al, patients with CBD diameter of 6mm or >6mm has 5 times more chances of conversion to open cholecystectomy<sup>15</sup>.

In our study, six patients required conversion to open cholecystectomy. Thus, a conversion rate of 4.8% was observed. This is in accordance with the conversion rates observed in most recent series (3-5%)<sup>8,16,17</sup>.

In the present study, we formulated a pre operative USG score which is simple and purely ultrasonological with eight parameters which were highly predictive of a difficult laparoscopic cholecystectomy. In this study, patients having a score of 4 or >4 had a 83.78% chances of facing intraoperative difficulties during laparoscopic cholecystectomy and a 10.81% chances of being converted to open cholecystectomy. A significant increase in the percentage of difficult laparoscopic cholecystectomy and conversion to open procedure was observed with an increase in the value of the score.

## Conclusion

This study has shown that preoperative USG findings such as GB wall thickness > 3mm, contracted or distended GB, presence of pericholecystic fluid collection, large stone, emphysematous cholecystitis, dilated CBD & impacted gall stone were significantly associated difficult laparoscopic cholecystectomy.

Gall bladder wall thickness and pericholecystic fluid collection are being the most accurate predictors for a difficult laparoscopic cholecystectomy followed by dilated CBD, gall stone mobility and transverse diameter of GB.

Higher the preoperative USG score, higher were the percentage of difficult laparoscopic cholecystectomy and conversion to open cholecystectomy.

From these observations, it is concluded that pre operative ultrasonography in the form of a formulated score is good predictor of difficulties during laparoscopic cholecystectomy.

## Declarations

**FUNDING:** None

**CONFLICT OF INTEREST:** None declared

**ETHICAL APPROVAL:** approved by ethics committee

## Limitation of the study

All surgeries were performed by different surgeon with different years of experience, so outcomes may differ.

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