

## **An Observational Study on Prediction of Difficulties During Laproscopic Cholecystectomy in Cases of Cholelithiasis by Preoperative Ultrasonography**

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Received: 10-01-2023 / Revised: 12-02-2023 / Accepted: 22-03-2023

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Conflict of interest: Nil

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### **Abstract:**

**Background:** Preoperative prediction of a difficult laparoscopic cholecystectomy not only helps in counselling the patient but also helps the surgeon to prepare better for intraoperative difficulties expected to be encountered.

**Methods:** A total of 125 cases of elective laparoscopy performed at SMS Hospital & attached group of hospitals, Jaipur from May 2021 to December 2022 were included in the study. A preoperative ultrasonography (USG) score was formulated with seven parameters which were highly predictive of difficulties during surgery.

**Results:** Of 125 patients studied, 42 (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. Gall bladder wall thickness > 3mm, contracted or distended gall bladder wall, presence of pericholecystis fluid collection, large stone, emphysematous cholemiastitis, dilated CBD, gall stone mobility and transverse diameter of GB were the most accurate predictors for a difficulty in laparoscopic cholangioplasty.

**Conclusion:** Pre-operative USG score is a good predictor of difficulties in a cholangio-pancreatoplasty.

**Keywords:** Laparoscopy, cholecystectomy, cholelithiasis, preoperative, sonography etc.

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### **Introduction**

In Within a short span of merely three decades since its introduction, laparoscopic cholecystectomy has become widely accepted as the procedure of choice for

symptomatic gall bladder diseases. With their growing experience in this surgery, the surgeons have started taking up more complex cases and high risk patients, some

of which were considered a relative contraindication a couple of years back.[1] 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, statistics still favours laparoscopic over open approach.[2] 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 helps 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.

When operating on a high risk patient, the surgeon has to make an early decision to convert if dissection seems to be very difficult as early conversion shortens the operation time and decreases morbidity[3-4].

Preoperative prediction of a difficult laparoscopic cholecystectomy and the risk of conversion is of great help both to the

patient who can plan his work and the surgeon who can also schedule his time and team accordingly.

### Material and Methods:

Current study was observational study conducted at the general surgery department of SMS Hospital & attached group of hospitals, Jaipur from May 2021 to December 2022. A total 125 cases of elective laparoscopic cholecystectomy were included in the study. 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. 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.

**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

Surgery done using CO<sub>2</sub> 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. All the intraoperative events were recorded. All cases received standard postoperative care and follow up.

**Table 2: Easy\difficult criteria**

Easy	Difficult
Time taken to dissect calots triangle < 25 min	Time taken to dissect calots triangle > 25 min
No bile spillage	Bile spillage\ stone spillage
No injury to duct\ artery	Injury to duct\ artery
Easy access to peritoneal cavity	Difficult access to peritoneal cavity
No conversion to open	Conversion to open

All the patients was be evaluated in terms of clinical, biochemical, haematological and USG parameters. Conversion rate and reason for conversion was noted. Reason for conversion were- Failure to proceed further, Abnormal anatomy, Injury to biliary tract or other viscera and Troublesome bleeding. Data were analysed in SPSS v- 24. Independent t-test and Chi-square test were applied.

### Results:

One hundred twenty five patients of cholelithiasis who underwent laparoscopic cholecystectomy were studied. Patient's demographic were recorded. Mean age of the patients was  $42.74 \pm 15.47$  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 performed, 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.(Table 3-5)

**Table 3: Conversion rate**

Preoperative USG score	Required conversion	No conversion	Total
0-1	0(0.0%)	43(100%)	43
2-3	2(4.44%)	43(95.5%)	45
$\geq 4$	4(10.81%)	33(89.19%)	37
Total	6(4.8%)	119(95.2%)	125

**Table 4: GB wall thickness & intraoperative difficulty**

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GB wall thickness	Difficult cases (n=42)	Easy cases (n=83)	p-value
>3mm	33	5	<0.001
< = 3mm	9	78	
AP diameter of GB (cm)			
<2, or >5	33	38	<0.001
2-5 cm	9	45	
Number of stones			

Multiple	25	48	0.991
Single	17	35	
Gall stone mobility			
Impacted	10	11	0.215
Mobile	32	72	
Size of stone			
>1cm	31	39	0.007
< = 1cm	11	44	
Pericholecystic collection			
Yes	28	2	<0.001
No	14	81	
Emphysematous cholecystitis			
Yes	1	0	0.992
No	41	83	
Diameter of CBD			
>6mm	5	2	0.007
<6mm	37	81	

**Table 5: Preoperative USG score & intraoperative difficulty**

USG score	Difficult cases	Easy cases	p-value
0-1	3(6.97%)	40(93.02%)	<0.001
2-3	8(17.7%)	37(82.2%)	
≥4	31(83.78%)	6(16.21%)	
Total	42	83	

## Discussion

In our study, dense adhesions causing problems in dissection and defining anatomy and bleeding (moderate to severe) have been taken as criteria for difficulty. In addition, increased operating time and conversion have been taken as criteria for difficult laparoscopic cholecystectomy. Comparisons can therefore, be made between difficult cases in our study and converted cases in previous studies.

The approach to our study through difficulty in operation and not conversion was logical due to two reasons. Firstly, not only patients requiring conversion to open cholecystectomy but also those patients posting difficulty during operation were expected to have a longer hospital stay. All these patients could also be considered at a higher-than-normal risk for conversion to open cholecystectomy. This is substantiated by previous studies which show adhesions and bleeding (from the

liver bed or cystic artery) as the major causes of conversion. Thus, the goals of better patient and surgeon information, administrative planning of hospital stay and patient selection for resident training, could as well be assessed through difficult operations as with conversion. Secondly, due to our sample size as compared to previous studies on conversion rates, not many patients were expected to be converted to open cholecystectomy. This was substantiated in the course of the study.

## Gall bladder wall thickness

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.

Thickened gall bladder wall was significantly associated with adhesions, bleeding and increased operative time. 4 out of the six converted patients had thickened gall bladder wall. Approximately 30% patients with thickened gall bladder wall had a positive history of acute cholecystitis.

According to Bedirli et al patients with thickened gall bladder wall have 8 times more chances of conversion to open cholecystectomy[5]. There were difficulties in exposure of biliary anatomy in such patients. These factors contributed to difficulties in retraction and increased chances of liver tears and bleeding from gall bladder bed, thus causing increased bleeding in these patients. A consequent increase in operating time was also noticed.

#### **Transverse diameter of gall bladder**

Gall bladder size also predicted difficult laparoscopic cholecystectomy in our study. 71 patients in our study had transverse diameter of GB <2cm or >5cm (contracted or distended) as a predictor of difficult laparoscopic cholecystectomy. Gall bladder transverse diameter was found to be a significant predictor of difficult laparoscopic cholecystectomy (p value= 0.001). this is in accordance to Talukder MI et al findings[6]. Logistic regression in their study, associated gall bladder distension as a sonographic sign associated with a high relative risk of conversion. Their study however, was a retrospective study. They have concluded that the predictive value of sonographic signs for conversion required further assessment in a prospective study.

In our study, we have evaluated this factor prospectively. Difficulties were encountered when a distended gall bladder was associated with a large stone impacted at the neck or a thickened gall bladder wall. A contracted GB on ultrasound was associated with adhesions, problems of

exposure and difficulty in separation of gall bladder from the liver.

In a study conducted by Lal et al.[7], contracted gall bladder on preoperative ultrasound was found to be one of the predictors for conversion of laparoscopic cholecystectomy to open cholecystectomy. Many others have identified a contracted gall bladder as a potential factor for conversion[8-10].

In our study, we encountered difficulties in the patients with contracted or distended gall bladder in the form of spillage of bile or stones, bleeding and thus increasing the operative duration. Also, 4 out of 6 cases which required conversion to open cholecystectomy had contracted or distended gall bladder on preoperative USG.

#### **Pericholecystic fluid collection**

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.[11]

Thus, presence of pericholecystic fluid was also a significant predicting factor for difficult laparoscopic cholecystectomy in our present study with an accuracy of 87.2%.

### Gall stone mobility

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.

Prime difficulty with a stone impacted at Hartmann pouch is that it hampers holding and maneuvering of the gall bladder neck while dissection. If stones are impacted, gall bladder forms a mucocele due to mucous collection and gall bladder becomes tense and thus, difficult to hold. These factors contributed to difficulties in exposure of biliary anatomy and increased chances of liver tears and bleeding from gall bladder bed, thus causing increased bleeding in these patients. A consequent increase in operating time was also noticed.

According to Fried et al, patients with impacted stone in GB have six times more chances of conversion to open cholecystectomy[2].

### Size of stone and number of stones

Many studies have reported statistical significance between the size of stones and conversion of laparoscopic cholecystectomy to open cholecystectomy [8-9]. Jansen et al stated that stone size more than 20mm was associated with increased risk of conversion.[12]

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%. Out of 42 difficult laparoscopic cholecystectomies, 31 (73.8%) had large stone (>1cm) on their preoperative USG. Out of the six cases which required conversion to open cholecystectomy, 4 had a large stone on preoperative USG.

Number of stones in GB had no significant link with difficulty during laparoscopic cholecystectomy (p value= 0.991). Although, if multiple stones are present

along with other factors like distended\contracted GB, or thickened gall bladder wall, then it may cause difficulty during laparoscopic cholecystectomy as it will be cumbersome to retrieve the spilled stones if spillage of bile or stones has occurred.

### Diameter of CBD

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 Schmidt M et al, patients with CBD diameter of 6mm or >6mm has 5 times more chances of conversion to open cholecystectomy.[13] They have associated contracted GB and thus, difficulties in holding & retraction of GB. These factors contributed to difficulties in exposure of biliary anatomy and increased chances of liver tears and bleeding from gall bladder bed, thus causing increased bleeding in these patients.

### Emphysematous cholecystitis

In our study, we found one case of emphysematous cholecystitis on preoperative USG which was tuned out to be difficult laparoscopic cholecystectomy. In that case, there was friable GB wall due to which we could not hold or grasp GB properly for dissection. Secondly, there were dense adhesions present resulting in bleeding but that was controlled. all these factors increased operative time but the case was completed by laparoscopic means without converting it to open procedure.

### Conversion to open cholecystectomy

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%).[9,11]

Most of the patients who required conversion to open cholecystectomy had thickened GB wall, contracted or distended GB, multiple stones, large stones and pericholecystic collection. Thus, we observed that pre operative USG parameters are very helpful in predicting conversion. There were various reasons of conversion. In one case, there was bile spillage and stone spillage occurred due to tear of fundus of gall bladder and massive bleeding occurred during dissection from liver bed, bleeding was unable to control by multiple measure, so it was opened and bleeding arrested after source identification. In another case, there were dense adhesions present between gall bladder and omentum and with surrounding structures due to inflammation, so during removing these adhesions and dissecting calots triangle duodenum was injured and in another patient CBD was injured. So, procedure was converted to open. In another patient, on elevation of liver, GB was densely adherent to surrounding structures and gangrenous, on further elevation perforation occurred at fundus of gall bladder and bile spillage occurred and because of difficulty in dissecting calots triangle, patient was opened.

### Preoperative USG score

Many studies have attempted to form a scoring system to predict difficult laparoscopic cholecystectomy, but most of them are complex, use large number of determining factors and thus, are difficult to use in day-to-day practice<sup>14-16</sup>. Many of these scoring systems cannot be applied pre operatively.<sup>17</sup>

In the present study, we formulated a pre-operative USG score which is simple and purely ultrasonological with seven 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. Majority of such patients have dense adhesions which make dissection and definition of biliary anatomy difficult. Moderate bleeding may be expected with contracted GB and those with thickened gall bladder wall. This consequently increases the operating time for such patients. 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.

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