

# Ultrasound Scoring System for Pre-Operative Anticipation of Difficult Laparoscopic Cholecystectomy

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## Abstract

**Background:** To develop a sonographic scoring criteria which would help the surgeons to predict the need for open cholecystectomy in cases in which laparoscopic surgery may be difficult and or may have a greater chance of conversion into an open cholecystectomy.

**Methods:** Ultrasound findings of 100 patients treated by laparoscopic cholecystectomy were analysed from January 2016 to march 2018. Four variables (time taken, duct or arterial injury, biliary leakage and conversion to open cholecystectomy) were reviewed to classify laparoscopic cholecystectomy as easy or difficult. The sonographic findings recorded were : gall bladder wall thickness, distended gall bladder , impacted stones, pericholecystic fluid, multiple stones, common bile duct diameter and liver size. Six variables out of total seven were taken to be statistically significant and a score of 2 was given to them. The rest of the parameters if positive were given a score of 1 each, amounting to a total score of 11. Finally, a value of 5 was considered to be cut off value to predict easy and difficult LC.

**Results:** Twenty two out of 24 patients with difficult laparoscopic cholecystectomy and 74 out of 76 patients with easy LC were predicted correctly on account of this scoring system. A total score of 5 or more had a sensitivity of 91.2% and specificity of 98.7% for accurately predicting difficult LC. Ultrasound parameters of Gall bladder wall thickness, GB distension, Stone impaction, number of stones, CBD dilatation and presence of pericholecystic oedema were calculated to be significant statistically.

**Conclusion:** Prediction of converting a difficult LC to OC can be done effectively by using an ultrasound score. Patients with higher score must be told preoperatively taking informed consent in written, scheduled suitably and anticipated early for conversion to OC.

**Key Words:** Ultrasound Scoring System, Pre-Operative anticipation, Open cholecystectomy, Laparoscopic cholecystectomy .

## Introduction

Laparoscopic cholecystectomy (LC) has established itself as the procedure of choice for management of symptomatic gallbladder (GB) disease.<sup>1-3</sup> Its advantages that have made considerable impact are its minimal invasive nature, reduced postoperative pain, better cosmetic results and wound healing, shorter hospital stay, and early recovery.<sup>4</sup> However up to 15% of patients need conversion to open cholecystectomy (OC) for multiple reasons.<sup>5,6</sup> The prediction of a difficult laparoscopy and possibility of conversion into an open cholecystectomy is almost impossible clinically.

It would be useful for both surgeons and the patients if they could somehow predict these difficulties beforehand, one of the ways this could be done is by using ultrasound to detect the situation of the gall bladder disease. There is no ultrasound based scoring system available at present to help predict the factors that could lead to a difficult laparoscopic cholecystectomy or may result in conversion to an open cholecystectomy. Our aim was to come up with a standardized ultrasound based scoring system, which can predict a difficult laparoscopic surgery as well as allow selection of patients who may require conversion to open cholecystectomy

## Patients and Methods

Preoperative data of 100 patients who underwent laparoscopic cholecystectomy between January 2016 and March 2018 by two consultant surgeons were reviewed. All the patients with symptomatic gall stones were included . Exclusion criteria was patients where laparoscopic cholecystectomy was done as emergency surgery or where reason for conversion to open cholecystectomy was done due to unavailability

of required equipment, unfit for anaesthesia or due to other co-morbidities. Ultrasound was performed by 2 radiologists, using Toshiba Xario-100 ultrasound scanner equipped with 3.5-MHz and 5-MHz curved array transducer. After at least an 8-hour fasting, the patients were examined in the supine and the left lateraldecubitus positions. These 7 sonographic findings were analysed: (i)the thickness of the gall bladder wall, (ii) the transverse diameter of the GB, (iii)presence of a pericholecystic collection,(iv) the number of stones in the gall bladder, (v)mobility of stones, (vi)the diameter of the common bile duct (CBD), and (vii) the size of the liver (Figs. 1 and 2). A gall bluffer (GB) stone was considered to be present when a well-defined echogenic lesion with posterior acoustic shadowing was seen in the lumen on multiple planes. GB wall thickness was calculated by measuring the maximum thickness of the anterior wall adjacent to the liver. Gall bladder wall thickness was considered thick if it measured more than 3 mm. The gall bladder was labelled as distended if it measured more than 5 cm in transverse dimension. Pericholecystic fluid was meticulously assessed as well. The number of stones was recorded as single or multiple. Stone mobility was established by changing patient position during the scans, and if the stones moved, they were taken to be mobile. The widest diameter of the CBD was recorded, and if its maximum diameter was greater than 6 mm it was considered to be dilated. Liver was considered enlarged when its length was greater than 15.5 cm. After recording all these details, score of 2 was given for presence of each significant finding and a score of 1 was given for remaining parameters, so the total score was 11 (Table 1). A cut-off value of 5 was taken to predict easy (score of 5 or less) and difficult laparoscopy (score more than 5). All of patients were subjected to surgery between 2 h and 7 days after ultrasound examination. Two experienced surgeons performed the surgeries. Laparoscopic cholecystectomy was performed using an established four-puncture technique with two 5 mm and two 10 mm ports. Intraoperative cholangiography was also done in cases of suspicion of CBD stones. The following four parameters assessed by the surgeon to label laparoscopic cholecystectomy as easy or difficult were, time taken more than 60 min, injury to duct or artery, presence of biliary leakage and conversion to open cholecystectomy. Chi-square test was used to find the significant association of findings of preoperative sonographic score with per operative outcome of difficult laparoscopic cholecystectomy. A p value <0.05 was considered to be significant.

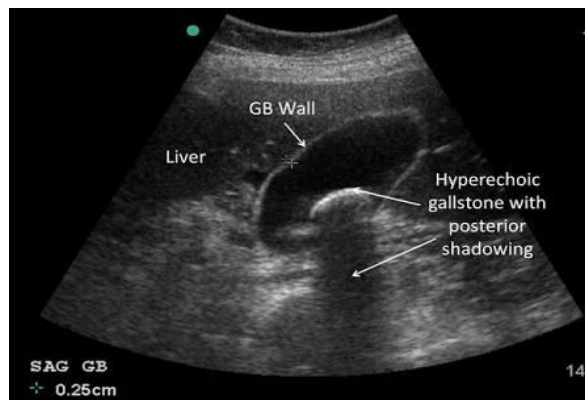


Fig 1. Longitudinal section of gall bladder containing stone



Fig 2: Longitudinal section of a normal calibre bile duct common bile duct

## Results

A total of 100 patients underwent laparoscopic cholecystectomy, due to clinical features suggestive of GB stones. None of patients required conversion from LC to OC. Male to female ratio was 37: 13. Mean age of patients was  $46.69 \pm 10.41$  years. Ultrasounds of all patients revealed gall bladder wall thickness of  $3.96 \pm 1.67$  cm, CBD diameter  $5.88 \pm 1.62$  cm, liver size  $16.47 \pm 1.89$  cm. Time taken to complete surgery was  $82 \pm 33.83$  minutes. (Table 2). In regards to frequency distribution, pain RHC was observed in 92%, vomiting in 24%, fever in 18%, impacted stones in 14%, pericholecystic oedema in 16% and more than 1 stone in 27% of patients. (Table 3). Twenty four patients were predicted to be difficult whereas 76 patients were predicted to be easy using ultrasound scoring parameters. Twenty two out of 24 and 74 out of 76 cases were predicted correctly (Table 4). It was also seen that a score of 5 or more was shown to have a sensitivity of 91.2%, specificity of 98.7% and accuracy of 96.6% for predicting the outcome of surgery to be difficult or easy. The prediction was found to be coming true in 97.3% for difficult cases and 84.6% in the cases for easy LC. Ultrasound parameters used in ultrasound scoring system like GB wall thickness, GB

distension, stone impaction, CBD dilatation, pericholecystic oedema and number of stones >1 were also evaluated and p value of <0.05 was calculated, showing to be significant. (Table 5). Although enlarged liver was seen in difficult LC but it was not associated significantly.

**Table 1. Ultrasound scoring system.**

Ultrasound parameters	Score
GB wall thickness ≥4 mm	2
Transverse diameter of GB ≥5 cm	2
Presence of impacted stones	2
CBD diameter >6 mm	2
Presence of pericholecystic collection	1
Number of stones >1	1
Liver size ≥ 15.5 cm	1

**Table 2. Descriptive statistics**

Variables	N=100
Age	46.69± 10.41 (range 20-77) years
Men: Women	26:74
Gall bladder wall thickness	3.96± 1.67 (1-8)cm
Common bile duct diameter	5.88 ± 1.62 (3-13) mm
Liver size	16.47± 1.89 9(13-25) cm
Duration of surgery	82± 33.82 (30-150) minutes

**Table 3: Clinical manifestations**

Variable	Percentage
Pain Right Hypochondrium	92%
Vomiting	24%
Fever	18%
Impacted stones	14%
Pericholecystic oedema	16%
More than 1 stone	27%

**Table 4. Result of ultrasound scoring parameters regarding laparoscopic cholecystectomy prediction**

		Laparoscopic cholecystectomy	
		Difficult	Easy
Ultrasound score	Score >5	22	2
	Score <5	2	72

## Discussion

Since the dawn of laparoscopy in general surgery, it has radically changed the scope of surgery as it is possible to access all intraperitoneal and retroperitoneal organs. Cholelithiasis is immensely impacted by laparoscopy and now LC has replaced

**Table 5. Analysis for statistical significance**

Ultra-sonographic findings		Difficult LC	Easy LC	p-value
Thickened gall bladder wall	+	24	32	<0.05
	-	0	44	
GB distension	+	24	39	<0.05
	-	0	36	
Stone impaction	+	12	02	<0.05
	-	12	74	
CBD Dilatation	+	19	38	<0.05
	-	05	38	
Pericholecystic oedema	+	13	03	<0.05
	-	11	73	
Stone multiplicity	+	22	50	<0.05
	-	02	25	
Enlarged liver	+	18	54	0.71
	-	06	22	

open surgery as gold standard<sup>1-3</sup>. Its wide range of advantages like smaller incisions, minimal invasion, less pain, shorter hospital stay, early discharge, quicker return to normal lifestyle and better cosmetic results, are globally accepted.<sup>4,6</sup>

Although a surgeon must anticipate aberrations in anatomy, anomalous ducts and inflammatory adhesions pre-operatively, it is difficult to assess on signs and symptoms of the patient whether a LC is going to be difficult or easy. Older age, male sex, morbidly obese and poor control of comorbid conditions also play contributory role. This leads to per-operative decision to convert to open cholecystectomy.<sup>5,6</sup>

Ultrasonounds are done in all these patients to confirm the diagnosis. Although the investigation modality of choice for gall stone disease, there are no standard parameters or findings that would predict intra-operative difficulties or complications.<sup>7</sup> Different studies have been attempted in this context. All studies have included gall bladder wall thickness as a primary risk factor. A gall bladder wall thickness ranging from 3 to 6mm is significantly reported to be in association with conversion to open cholecystectomy.<sup>8-12</sup> So in our study a gall bladder wall thickness of 4mm or more was predictive of a difficult LC. This change in thickness of GB wall is attributed to inflammatory changes causing pericholecystic oedema<sup>13</sup>. Operation becomes more difficult because of vascular inflammatory adhesions as these patients are prone to GB rupture causing bile to spread in peritoneal cavity. Chronic cholecystitis is associated with deranged anatomy and densely attached gall bladder to its bed.

Other parameters included in our study were distended gall bladder, impacted stones and dilated CBD. Cho et al. concluded a LC to be difficult in presence of gall bladder distension.<sup>14</sup> Gall bladder stone impacted at its neck has been of great debate in context of difficulty in LC. Randhawa et al. concluded no association between these two.<sup>15</sup> However according to our conclusion, impacted stones are significantly associated with difficult LC. Similarly, CBD distension is also reported to be significant regarding prediction of difficult LC as concluded by Cho et al and Daradkeh et al.<sup>7,14</sup> Contrary to other researchers, we found considerable significance for stone multiplicity and pericholecystic oedema. Enlarged liver was evaluated to be insignificant as supported by other authors.<sup>7,10,15</sup>

Conversion to open cholecystectomy is usually criticised but it is better to submit than commit as patient's safety comes first. So a surgeon should swallow his pride and should not hesitate to convert to open as it is not taken as a failure. In our study no conversion was needed owing to expertise available. We recommend all these difficult predicted cases should be preferably done by experienced surgeon so as to avoid complications anticipated during learning curve. It is also recommended to take informed high risk consent in such patients regarding bleeding, bile leakage and need to convert to open cholecystectomy. This scoring system is helpful in predicting difficult or easy LC. A score of 5 or more has a sensitivity of 91.2%, a specificity of 98.7% and an accuracy of 96.6% with positive predictive value of 95.7%. We can allocate predicted difficult cases to more experienced surgeons using this scoring system.

## Conclusion

1. It can be predicted and anticipated whether LC to be difficult or easy on the basis of ultrasound examination and this scoring system. Other systemic factors must be taken into account besides it. Other diagnostic modalities like MRI can improve this predictability.

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