

A CORRELATIVE STUDY BETWEEN PREOPERATIVE USG FINDINGS AND DIFFICULT LAPAROSCOPIC CHOLECYSTECTOMY

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ABSTRACT

Background: Laparoscopic cholecystectomy (LC) is the gold standard for gallbladder pathology and has various advantages over open cholecystectomy (OC), such as less postoperative pain and faster recovery. This research aims to determine whether preoperative USG findings can be used to predict conversion from LC to OC. **Methods:** This prospective observational research was done between December 2023 and November 2024 at Fakhruddin Ali Ahmed Medical College and Hospital, Barpeta, Assam. All 200 cholelithiasis-diagnosed patients were enrolled, fulfilling the indications of laparoscopy. All patients underwent preoperative USG to determine the status of gallbladder (contracted, normal, distended, and overdistended), wall thickness in mm, stone size in cm, number of stones, and presence of pericholecystic fluid. **Results:** Amongst 200 patients, 65% were women and 35% were men with a mean age of 42.5 years. 70% of the patients had overdistended or normally distended gallbladders, and 30% had contracted gallbladders. Wall thickness greater than 3 mm was present in 48.5% of the patients, and 49% had pericholecystic fluid. The size of the stones greater than 1 cm was present in 45% of the cases. Among the 200 patients, 90% were successfully operated upon using laparoscopic cholecystectomy, while 10% required conversion to open surgery. The preoperative USG findings, such as gallbladder wall thickening, large gallstone, and pericholecystic fluid, were strongly predictive of conversion to OC. Multivariate analysis showed these ultrasound factors, along with gallbladder status, as independent predictors of conversion ($p < 0.05$). **Conclusion:** Preoperative ultrasonography provides valuable information on predictors of conversion from laparoscopic to open cholecystectomy. From this study, incorporation of preoperative USG findings into the intraoperative plan has been suggested as a means of identifying high-risk patients, reducing patient complications, and minimizing complications due to open surgery conversion.

Keywords: Laparoscopic cholecystectomy, ultrasound, preoperative predictors, complications.

INTRODUCTION

Laparoscopic cholecystectomy (LC) is currently recognized as the gold standard for treating gallstone disease and other benign gallbladder conditions. This minimally invasive procedure offers several benefits over open cholecystectomy (OC), including reduced postoperative pain, shorter hospital stays, quicker recovery times, and better cosmetic outcomes^{1,2,3,4,5}. However, some patients may need to convert to OC due to complications such as obscure anatomy, bleeding, or severe inflammation during surgery. Identifying such high-risk patients early in the surgical process is essential for enhancing surgical planning and improving outcomes. Conversion to OC is necessary when complications compromise patient safety or make laparoscopic dissection impractical. Factors such as thick adhesions, bile duct abnormalities, and severe gallbladder inflammation can complicate the procedure⁶. Although conversion can lead to increased morbidity, including surgical site infections with the invitation of many nosocomial infections like pneumonia and longer hospital stays⁷. These hurdles can be averted by preoperative risk assessment, facilitating better patient counseling and resource allocation.

Several clinical parameters serve as significant predictors for conversion from laparoscopic to open cholecystectomy. Studies have identified attributes like advanced age, male gender, and previous abdominal surgery as significant risk factors due to their association with increased adhesion formation^{7,9}. Obesity poses technical challenges due to intra-abdominal fat interfering with the procedure. Patients with symptomatic acute cholecystitis, presenting with

severe right upper quadrant tenderness, fever, and palpable gallbladder, are also more likely to require conversion due to inflammation and fibrosis¹⁰.

In addition to the clinical judgment, hematological examinations provide valuable clues in risk assessment. Elevated WBC and CRP levels indicate significant inflammation, while abnormal liver function tests may suggest bile duct obstruction or choledocholithiasis, potentially necessitating conversion¹¹. Coagulopathies must be excluded to prevent intraoperative bleeding complications. Apart from these, ultrasonographic findings like a thickened gallbladder wall (>3 mm) strongly indicates potential demand of conversion due to chronic inflammation or fibrosis⁸. Also contracted gallbladder correlates with high conversion rates due to associated adhesions⁹, while pericholecystic fluid suggests severe cholecystitis¹⁰. Additionally, larger stones (>10 mm) present technical challenges and are linked to increased conversion rates¹².

AIM

1. To develop a comprehensive scoring system base on preoperative risk stratification by using clinical and laboratory predictors
2. To predict the possibility of conversion of procedure by use of the scoring system

METHODOLOGY

A prospective observational study was conducted amongst the subjects admitted for the cholecystectomy in the Department of General Surgery, FAAMCH Barpeta, Assam, from December 2023 to November 2024. The study examined specific ultrasound parameters, including gallbladder status, wall thickness, stone characteristics, and pericholecystic fluid, as predictors of intraoperative complications. A total of 200 patients with cholelithiasis were enrolled in the study, determined through calculations made using prevalence in prior literature¹⁴ with a confidence interval of 95% and a significance level of 5%, yielding a sample size 198. A convenient sampling design was adopted, and the enrollments were made in a consecutive approach to minimize selection bias. Patients were categorized post-operatively into successful laparoscopic cholecystectomy cases and those requiring conversion. The study meticulously documented intraoperative complications, USG features, inflammation grade, adhesions, and anatomical variants. Standardized surgical and data collection protocols ensured consistency, with the primary outcome focusing on the correlation between conversion rates and preoperative ultrasound parameters.

Inclusion and exclusion criteria

Patients between 20 and 70 years consenting for the study were enrolled in the study, whereas patients with common bile duct calculi, obstructive jaundice, suspected malignancy, prior abdominal surgery and medically unsuitable for laparoscopic surgery were excluded.

Statistical analysis

The collected data was input into an Excel spreadsheet, and analysis was performed using Epi Info 7. Descriptive statistics were used to summarize patient demographics and clinical variables. Categorical variables were analyzed with the Chi-square test, while continuous variables were assessed using the Student's t-test, with a significance level set at $p < 0.05$. Multivariate logistic regression identified independent predictors of conversion, adjusting for factors like age, BMI, and gallbladder pathology severity. Results were displayed in tables with proportions and statistical outcomes to illustrate the predictive value of preoperative ultrasound findings on surgical outcomes.

RESULTS

The study included 200 patients, with most being females (65%), reflecting the higher prevalence of gallstone disease in females. Most of these patients presented with overdistended (39.5%) and 30% with contracted gall bladder. About 48.5% of them presented with thickened walls suggesting inflammation. Additionally, 58.5% had multiple stones, and 49% exhibited pericholecystic collection, indicating localized inflammation. These findings are crucial for understanding ultrasound parameters' relationship with surgical outcomes (Table 1).

Table 1: Distribution of Demographic and Clinical Variables in Gallbladder Ultrasound Findings

Parameter	Attributes	Frequency	Percentage
Gender	Female	130	65.0
	Male	70	35.0
GB Status	Contracted	60	30.0
	Normal distended	61	30.5
	Overdistended	79	39.5
GB Wall Thickness	<3 mm	103	51.5
	>3 mm	97	48.5
Number of Stones	Multiple	117	58.5
	Single	83	41.5

Ultrasound assessment categorized gallbladder (GB) status as normal, overdistended, or contracted, noting variations in wall thickness, stone count, pericholecystic collection, and stone size. Increased wall thickness and multiple stones indicated greater complexity, while pericholecystic collection suggested inflammation. Stone sizes varied, with 37.5% (<5 mm), 43.5% (5 mm-10mm), and 19% (>10mm). Larger stones (>10mm) were linked to higher surgical difficulty, impacting intraoperative outcomes.(Table 2)

Table 2: Score for criteria.

Criteria	1 (Normal distended)	2 (Overdistended)	3 (Contracted)
GB status	Normal	Overdistended	Contracted
GB wall thickness	<3mm	>3mm	
Number of stones	Single	Multiple	
Pericholecystic collection	Absent	Present	
Stonesize	<5mm	5mm-10mm	>10mm

Key ultrasound parameters, such as gallbladder status, wall thickness, number of stones, pericholecystic collection, and stone size, were used to create a composite ultrasound score to evaluate conversion risk. Scores ranged from 5 to 12, with the most common score being 8, indicating moderate risk. Most patients (81%) fell into the moderate difficulty category, while 19% were classified as high difficulty.* Higher scores correlated with increased surgical complexity and longer operative time. (Table 3)

***Criteria for the level of difficulty during procedure**

Easy	Difficult
Time taken<60 min	Time>60 min
No difficulty in dissection	Difficulty in dissection
No biliary or stone spill	Stone & biliary spill
	Required bail-out procedure like laparoscopic subtotal cholecystectomy
	Required conversion to open

Table 3: Distribution of Scores, Difficulty Levels, and Criteria for Easy and Difficult Gallbladder Procedures

Score	Frequency	Percent
5	28	14.0
6	34	17.0
7	38	19.0
8	62	31.0
9	22	11.0
10	6	3.0
11	7	3.5
12	3	1.5
Score		
High difficulty	38	19.0
Moderate difficulty	162	81.0

Intraoperative difficulty levels were categorized as easy (15%), moderate (40%), and difficult (45%), with nearly half of the procedures deemed highly difficult due to complex anatomy or inflammation noted beforehand. Although 55% of cases were classified as difficult and 45% were not, about 90% of patients successfully underwent laparoscopic cholecystectomy, while 10% required conversion to open surgery due to inflammation or technical challenges. (Table 4)

Table 4: Operative Procedure Distribution

Assessment	Grades	Frequency	Percentage
Difficulty Level according to the time taken for procedure	Easy	30	15.0
	Moderate	90	45.0
	High	80	40.0
Difficulty Level	Difficult	110	55.0
	Not Difficult	90	45.0
Operative result	laparoscopic	180	90.0
	open	20	10.0

Among the key factors identified for conversion of laparoscopic surgery to open surgery, gender seems to have no relevance ($p>0.05$). However, factors like, gallbladder status, wall thickness ($>3\text{mm}$), pericholecystic collection and large stones had a strong association with conversion ($p<0.05$). Additionally, higher intraoperative difficulty levels and composite ultrasound scores correlated with increased conversion risk. (Table 5)

Table 5: Association between demographic procedure and clinical variables with Operative Procedure

Clinical Variables	Attributes	Procedure		Total	P value
		Laparoscopic	Open		
Gender	Female	118	12	130	p-value = 0.621
	Male	62	8	70	
GB Status	Contracted	47	13	60	p-value = 0.001
	Normal	57	4	61	
	distended	76	3	79	
	Over distended				
GB Wall Thickness	$<3\text{ mm}$	98	5	103	p-value = 0.003
	$>3\text{ mm}$	82	15	97	
Number of Stones	Multiple	104	13	117	p-value = 0.534
	Single	76	7	83	
Pericholecystic Collection	Absent	96	6	102	p-value = 0.048
	Present	84	14	98	
Stone Size	$<5\text{ mm}$	73	2	75	p-value = 0.033
	$>1\text{ cm}$	28	10	38	
	$5\text{ mm} - 1\text{ cm}$	0	8	87	
Difficulty Level	Easy	23	7	30	P-value = 0.009
	High	80	10	90	
	Moderate	77	3	80	
Score	5	28	0	28	p-value = 0.012
	6	34	0	34	
	7	38	0	38	
	8	59	3	62	
	9	20	2	22	
	10	1	5	6	
	11	2	4	6	
Difficulty Level	Difficult	105	5	110	p-value = 0.000
	Not Difficult	75	15	90	

While no significant difference was found in terms of gender ($p>0.05$), other variables like gallbladder status, wall thickness ($>3\text{ mm}$), multiple stones, pericholecystic collection, and large stone ($>10\text{mm}$) were significantly associated ($p<0.05$) with higher difficulty. Higher composite ultrasound scores indicated more challenging surgeries, emphasizing the value of preoperative ultrasound in planning and risk management. (Table 6)

Table 6: Association between Demographic and Clinical Variables with Intraoperative Difficulty Level

Variables	Attributes	Difficulty Level		Total	P value
		Difficult	Not Difficult		
Gender	Female	65	65	130	p-value = 0.053
	Male	45	25	70	
GB Status	Contracted	35	25	60	p-value = 0.015
	Normal distended	32	29	61	
	Overdistended	43	36	79	
GB Wall Thickness	$<3\text{ mm}$	57	46	103	p-value = 0.042
	$>3\text{ mm}$	53	44	97	
Number of Stones	Multiple	67	50	117	p-value = 0.047
	Single	43	40	83	

Pericholecystic Collection	Absent	54	48	102	p-value = 0.012
	Present	56	42	98	
Stone Size	<5 mm	42	33	75	p-value = 0.015
	>1 cm	22	16	38	
	5 mm– 1 cm	46	41	87	
Score	5	15	13	28	p-value = 0.007
	6	21	13	34	
	7	11	27	38	
	8	42	20	62	
	9	14	8	22	
	10	1	5	6	
	11	4	3	7	
	12	2	1	3	

DISCUSSION

The current study was aimed at looking out for how well preoperative ultrasound can predict the need for conversion of a laparoscopic cholecystectomy to an open surgery. It was found that certain ultrasound features—like gallbladder shape, wall thickness, fluid around the gallbladder, and stone size—are important indicators of surgical difficulty and conversion risk. These results align with previous studies that highlight the value of preoperative imaging in surgical planning. Few studies concluded that a contracted gallbladder was linked to a higher conversion rate of **21.7%**. This may be due to an abnormal gallbladder shape, often indicating chronic inflammation, making surgery harder^{13,14}. This was supported by other authors stating difficulty in laparoscopic procedures owing to adhesion in the contracted organ¹⁵. A gallbladder wall thicker than **3 mm** proved to be a significant predictor, with a **15.5%** conversion rate and posing difficulties in laparoscopic procedures, consistent with other studies^{16,17}. The size of the gallstone (>10mm) rather than the number was found to be an explanatory variable in the conversion rate of the procedure with **26.3%** in the current study, relating to other studies performed earlier in similar settings^{13,14,18,19}. Pericholecystic fluid accumulation being a typical evidence of active inflammation or perforation also indicated an increased level of difficulty of the procedure and a higher risk of conversion¹⁶. Our study also evaluated the use of a composite ultrasound scoring system to stratify operative risk. The scoring system accurately identified patients with higher risks for conversion. Also, higher preoperative scores were linked to more procedural changes as is consistent with earlier studies²⁰. So it could be concluded that including various ultrasound factors helps improve risk assessment, aiding in better surgical planning and readiness.

Implications

The results of ultrasound help identify patients at increased difficulty levels and higher risk of conversion to open surgery, improving surgical planning and patient outcomes. This predictive approach also reduces costs by preventing unexpected intraoperative complications.

CONCLUSION

The current study highlighted the significance of preoperative ultrasonography in predicting technical difficulty and conversion risk during laparoscopic cholecystectomy, taking into account various morphological characteristics that may influence surgical outcome. While demographic trends have no significant effect on the procedure, other predictors related to the morphology and pathology of the gallbladder at the time of presentation as assessed by ultrasound has a significant impact on the difficulty and changes in the surgical procedure. The development of a multifaceted ultrasound score with strong predictive value allowed for better risk stratification, surgical planning, and patient counseling. The integration of a scoring system into routine preoperative assessment can enhance surgical safety, resource utilization, and ultimately patient outcomes.

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