

# Study On Correlation Of Preoperative Usg Findings With Intraoperative Difficulty Among Patients Undergoing Elective Laparoscopic Cholecystectomy

Dr. Prasanna P,<sup>1\*</sup> Dr. Mathivanan,<sup>2</sup> Dr. Shriram,<sup>3</sup> Dr. Ravichandran<sup>4</sup>

Postgraduate, Department Of General Surgery

Professor, Department Of General Surgery

Associate Professor, Department Of Radiology

Head Of The Department, Department Of General Surgery, Aarupadai Veedu Medical College, Vinayaka Mission's Research Foundation (Vmrfd) Puducherry, India

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## Abstract

**Background:** Cholelithiasis or gallstones are hardened deposits of digestive fluid which form in the gallbladder. Conversion of laparoscopic to open cholecystectomy occurs usually in patients with friable gall bladder, bleeding obscuring the view, inadequate exposure of calot's triangle, and oedematous gall bladder. Chance of this conversion from laparoscopic to open cholecystectomy can be estimated if the surgeon has reliable pre operative predictive factors. So in this study correlation of the USG findings and its criteria with intraoperative difficulties is being studied.

**Objective:** The present study was aimed to understand and utilize the pre operative USG findings and criteria for better prediction of intra operative difficulties during lap cholecystectomy

**Methods:** This prospective analytical study was conducted from September 2022 to July 2024 at AVMCH's Department of General Surgery. 57 patients were included. Patients scheduled for elective laparoscopic cholecystectomy were taken as source of study population.

**Results:** The mean patient age was 48.5 years. Females are commonly affected(77.2%). Ultrasound findings showed normal gallbladder size in 89.5%, multiple stones in 84.2%, and stones >1 cm in 21.1%. Duration of above 120 minutes found to be correlated significantly with aberrant anatomy, CBD size above 8 mm, and gallbladder wall thickness more than 4 mm. Dissection of Calot's triangle and gallbladder bed lasting >20 minutes was associated with gallbladder wall thickness >4 mm and multiple stones. Complications such as gallbladder tear and bile spillage (14%) were frequent in patients with a gallbladder wall thickness >4 mm and stones impacted at the gallbladder neck. Conversion to open cholecystectomy was necessary in 3.5% of cases.

**Conclusion:** Ultrasound parameters like as gallbladder wall thickness, size of common bile duct and presence of multiple stones at the neck are important in anticipating surgical complexities and guiding treatment decisions.

**Keywords:** Laparoscopic cholecystectomy, Ultrasonography, Surgical complications, Gallbladder wall thickness, Common bile duct

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## I. Introduction

Cholelithiasis or gallstones are hardened deposits of digestive fluid which form in the gallbladder. It is commonly treated with an open cholecystectomy. But with the newest advancements in technology, laparoscopic cholecystectomy has enabled minimally invasive surgery with low intraoperative and postoperative problems.<sup>[1]</sup> USG is an accurate mode of examination for diagnosing cholecystitis and cholelithiasis which showed a sensitivity of 50-75% in detecting CBD calculi.<sup>[2-4]</sup> So, before planning surgery, the USG results and criteria are utilized to analyze various challenges that a surgeon may encounter during a Laparoscopic cholecystectomy operation, as well as the possibility of converting the procedure to an open cholecystectomy on the table.

Conversion of laparoscopic cholecystectomy to open cholecystectomy occurs usually in patients with friable gall bladder, bleeding on manipulation obscuring the view, inadequate exposure of calot's triangle, and oedematous gall bladder.<sup>[2]</sup> Chance of this conversion from laparoscopic to open cholecystectomy can be estimated if the surgeon has reliable pre operative predictive factors. So in this study correlation of the USG findings and its criteria with intraoperative difficulties is being studied.

**Objective:**

The present study was aimed to understand and utilize the pre operative USG findings and criteria for better prediction of intra operative difficulties during lap cholecystectomy

**II. Materials And Methods**

**Type of study:** Prospective analytical study

**Study site:** AVMCH - Department of General Surgery

**Source of patients:**

Patients scheduled for elective laparoscopic cholecystectomy were taken as source of study population.

**Sample size:** 57 Patients

**Selection criteria:**

Patients aged 18 years and older, excluding patients with a history of more than three previous abdominal surgeries, CBD dilation >10mm, CBD stone, pancreatitis.

**Parameters assessed:**

- Gall bladder wall thickness, size
- Pericholecystic fluid,
- Gall stone characteristics,
- CBD size,
- Vascularity around Calot’s triangle, and aberrant anatomy,
- Total surgery
- Time to dissect Calot’s triangle
- Bile spillage
- Gall bladder tear
- Bleeding,
- Gall bladder extraction time were assessed.

The expected outcomes focused on better predicting surgical difficulties, reducing operative time and complications, improving patient counselling regarding conversions, and ultimately lowering morbidity and mortality rates.

**Statistical analysis:**

Statistical analysis involved summarizing data using mean, standard deviation, frequency, and percentage, with comparisons were done using t-test for numerical variables and chi-square tests for categorical parameters, considering a significance level of  $p < 0.05$ .

**III. Results:**

In present study total of 57 patients fulfilling inclusion criteria are included with mean age of patients 48.5yrs. Among included patients, 77.2% were female patients and 22.8% were male patients, with female preponderance in present study.

On ultrasound investigation, gall bladder size was normal in 89.5%, number of stones were multiple in 84.2%, with more than 1cm size was seen in 21.1%, pericholecystic fluid was present in 10.5%, with 3.5% aberrant anatomy, 14% with gas in gall bladder, 71.9% with presence of liver mobility, 22.8% with common bile duct size >8mm, 19.3% with GB wall thickness >4mm and stone impacted at GB neck was seen in 12.3% of the patients (Table 1).

**Table 1: Showing the ultrasound findings among patients**

		Count	Column N %
Gall Bladder size	Contracted	2	3.5%
	Distended	4	7.0%
	Normal	51	89.5%
Number of stones	Multiple	48	84.2%
	Single	9	15.8%
Size of stone	<1cm	45	78.9%
	>1cm	12	21.1%
Pericholecystic fluid	Absent	51	89.5%
	Present	6	10.5%

Aberrant Anatomy	Absent	55	96.5%
	Present	2	3.5%
Gas in Gallbladder	Absent	49	86.0%
	Present	8	14.0%
Liver mobility	Absent	16	28.1%
	Present	41	71.9%
Common bile duct size >8mm	<8mm	44	77.2%
	>8mm	13	22.8%
Gallbladder wall thickness >4mm	<4mm	46	80.7%
	>4mm	11	19.3%
Stone impacted at GB neck	Absent	50	87.7%
	Present	7	12.3%

**Table 2: Showing the intraoperative findings among patients**

		Count	Column N %
Surgery duration	<120min	44	77.2%
	>120min	13	22.8%
Calot triangle	<20min	50	87.7%
	>20min	7	12.3%
GB Bed	<20min	42	73.7%
	>20min	15	26.3%
Bile spill	Absent	49	86.0%
	Present	8	14.0%
Bleeding	1+	54	94.7%
	2+	3	5.3%
GBE Easy	Absent	11	19.3%
	Present	46	80.7%
GBE difficult	Absent	48	84.2%
	Present	9	15.8%
Conversion to open cholecystectomy	Absent	55	96.5%
	Present	2	3.5%

At surgical findings, it was found to be with total surgery duration of >120 min in 22.8%, 12.3% with >20min to dissect calot triangle, 26.3% with >20min requirement for dissect GB bed. Bladder tear and bile spill was seen in 14% of patients, moderate bleeding (2+) was seen in 5.3%, extraction was easy in 80.7% of the patients and 3.5% required for the conversion (Table2).

**Table 3: Comparison of USG findings with intra-operative bleeding among patients**

		Bleeding				Chi-square (p-value)
		Mild		Moderate		
		Count	N %	Count	N %	
Gall Bladder size	Contracted	2	3.8%	2	40.0%	9.31 (0.01)
	Distended	4	7.7%	0	0.0%	
	Normal	46	88.5%	3	60.0%	
Number of stones	Multiple	43	82.7%	5	100.0%	1.02 (0.31)
	Single	9	17.3%	0	0.0%	
Size of stone	<1cm	41	78.8%	4	80.0%	0.04 (0.95)
	>1cm	11	21.2%	1	20.0%	
Pericholecystic fluid	Absent	46	88.5%	5	100.0%	0.64 (0.422)
	Present	6	11.5%	0	0.0%	
Aberrant Anatomy	Absent	50	96.2%	5	100.0%	0.199 (0.655)
	Present	2	3.8%	0	0.0%	

Gas in Gallbladder	Absent	44	84.6%	5	100.0%	0.89 (0.344)
	Present	8	15.4%	0	0.0%	
Liver mobility	Absent	14	26.9%	2	40.0%	0.38 (0.534)
	Present	38	73.1%	3	60.0%	
Common bile duct size >8mm	<8mm	42	80.8%	2	40.0%	4.306 (0.01)*
	>8mm	10	19.2%	3	60.0%	
Gallbladder wall thickness >4mm	<4mm	44	84.6%	2	40.0%	6.83 (0.01)*
	>4mm	8	15.4%	3	60.0%	
Stone impacted at GB neck	Absent	45	86.5%	5	100.0%	0.76 (0.38)
	Present	7	13.5%	0	0.0%	

On assessment of the USG findings with bleeding during surgery, there was significant relation of size of common bile duct >8mm and gall bladder wall thickness of >4mm among the patients (Table3).

**Table 4: Comparison of USG findings with duration of surgery among patients**

		Duration of surgery >120min				Chi-square (p-value)
		<120 min		>120min		
		Count	N %	Count	N %	
Gall Bladder size	Contracted	2	4.5%	2	15.4%	2.85 (0.23)
	Distended	4	9.1%	0	0.0%	
	Normal	38	86.4%	11	84.6%	
Number of stones	Multiple	35	79.5%	13	100.0%	3.15 90.07)
	Single	9	20.5%	0	0.0%	
Size of stone >1cm	<1cm	36	81.8%	9	69.2%	0.95 (0.32)
	>1cm	8	18.2%	4	30.8%	
Pericholecystic fluid	Absent	40	90.9%	11	84.6%	0.422 (0.516)
	Present	4	9.1%	2	15.4%	
Aberrant Anatomy	Absent	44	100.0%	11	84.6%	7.01 (0.001)*
	Present	0	0.0%	2	15.4%	
Gas in Gallbladder	Absent	37	84.1%	12	92.3%	0.56 (0.45)
	Present	7	15.9%	1	7.7%	
Liver mobility	Absent	12	27.3%	4	30.8%	0.061 (0.805)
	Present	32	72.7%	9	69.2%	
Common bile duct size >8mm	<8mm	41	93.2%	3	23.1%	28.29 (0.01)*
	>8mm	3	6.8%	10	76.9%	
Gallbladder wall thickness >4mm	<4mm	41	93.2%	5	38.5%	19.24 (0.01)*
	>4mm	3	6.8%	8	61.5%	
Stone impacted at GB neck	Absent	40	90.9%	10	76.9%	1.82 (0.17)
	Present	4	9.1%	3	23.1%	

On comparison of the USG findings with duration of surgery >120min, there was significant higher incidence with presence of aberrant anatomy, >8mm size of common bile duct and gall bladder wall thickness of >4mm (Table 4)

**Table 5: Comparison of USG findings with intra-operative time to dissect gall bladder bed among patients**

		Dissect gall bladder bed				Chi-square (p-value)
		<20 min		>20 min		
		Count	N %	Count	N %	
Gall Bladder size	Contracted	3	7.1%	1	6.7%	0.08 (0.996)
	Distended	3	7.1%	1	6.7%	
	Normal	36	85.7%	13	86.7%	
Number of stones	Multiple	38	90.5%	10	66.7%	4.71 (0.03)*
	Single	4	9.5%	5	33.3%	
Size of stone >1cm	<1cm	34	81.0%	11	73.3%	0.38 (0.534)
	>1cm	8	19.0%	4	26.7%	
Pericholecystic fluid	Absent	38	90.5%	13	86.7%	0.17 (0.680)
	Present	4	9.5%	2	13.3%	
Aberrant Anatomy	Absent	41	97.6%	14	93.3%	0.600 (0.439)
	Present	1	2.4%	1	6.7%	
Gas in Gallbladder	Absent	37	88.1%	12	80.0%	0.6 (0.43)
	Present	5	11.9%	3	20.0%	
Liver mobility	Absent	12	28.6%	4	26.7%	0.02 (0.88)
	Present	30	71.4%	11	73.3%	
Common bile duct size >8mm	<8mm	34	81.0%	10	66.7%	1.28 (0.258)
	>8mm	8	19.0%	5	33.3%	
Gallbladder wall thickness >4mm	<4mm	38	90.5%	8	53.3%	9.79 (0.02)*
	>4mm	4	9.5%	7	46.7%	
Stone impacted at GB neck	Absent	37	88.1%	13	86.7%	0.02 (0.885)

	Present	5	11.9%	2	13.3%	
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On comparison of the USG findings with the dissect of gall bladder bed time more than 20min was seen with higher incidence with multiple gall stones and if the gall bladder wall thickness was more than 4mm (Table5).

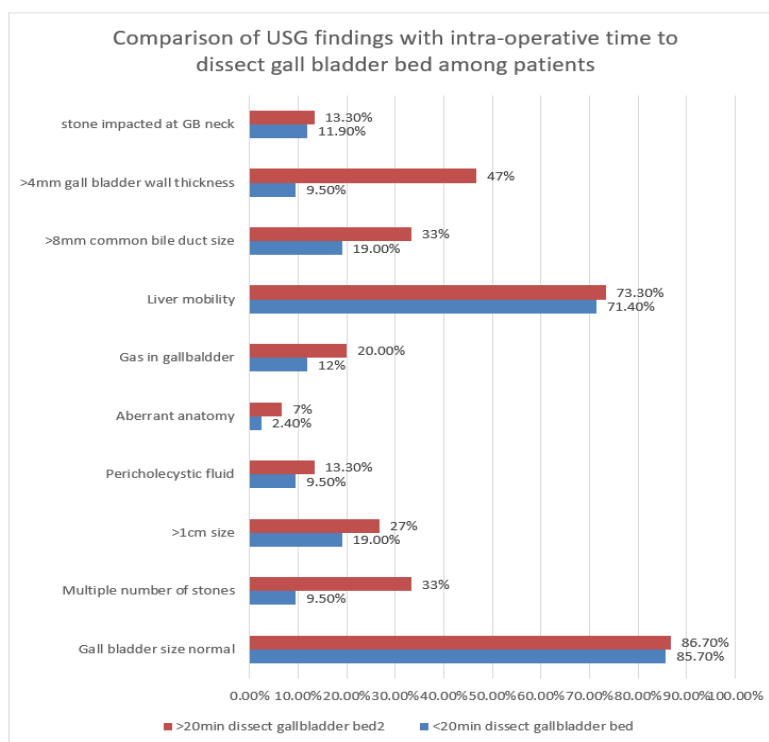


Figure 4: Comparison of USG findings with intra operative time to dissect gall bladder bed among patients

		Time to dissect Calot's triangle				Chi-square (p-value)
		<20 min		>20 min		
		Count	N %	Count	N %	
Gall Bladder size	Contracted	4	8.0%	0	0.0%	1.16 (0.56)
	Distended	3	6.0%	1	14.3%	
	Normal	43	86.0%	6	85.7%	
Number of stones	Multiple	43	86.0%	5	71.4%	0.98 (0.32)
	Single	7	14.0%	2	28.6%	
Size of stone >1cm	<1cm	41	82.0%	4	57.1%	2.28 (0.131)
	>1cm	9	18.0%	3	42.9%	
Pericholecystic fluid	Absent	44	88.0%	7	100.0%	0.93 (0.33)
	Present	6	12.0%	0	0.0%	
Aberrant Anatomy	Absent	48	96.0%	7	100.0%	0.29 (0.59)
	Present	2	4.0%	0	0.0%	
Gas in Gallbladder	Absent	42	84.0%	7	100.0%	1.30 (0.25)
	Present	8	16.0%	0	0.0%	
Liver mobility	Absent	15	30.0%	1	14.3%	0.751 (0.385)
	Present	35	70.0%	6	85.7%	
Common bile duct size	<8mm	40	80.0%	4	57.1%	1.822 (0.177)
	>8mm	10	20.0%	3	42.9%	
Gallbladder wall thickness	<4mm	44	88.0%	2	28.6%	13.92 (0.01)*
	>4mm	6	12.0%	5	71.4%	
Stone impacted at GB neck	Absent	43	86.0%	7	100.0%	1.11 (0.291)
	Present	7	14.0%	0	0.0%	

On comparison of the USG findings with Chalot triangle dissection time of more than 20 min was seen with significant higher incidence in if gall bladder wall thickness was >4 (Table 6).

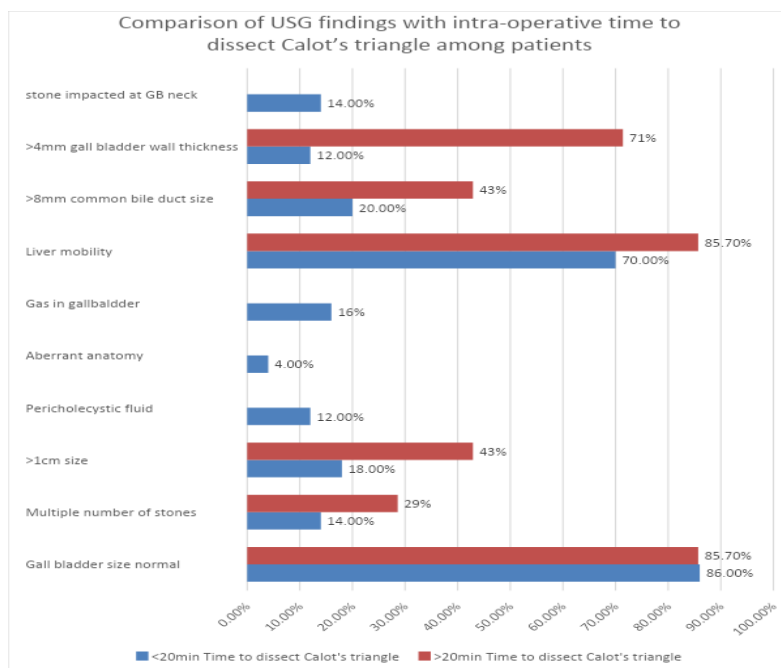


Figure 51: Comparison of USG findings with intra operative time to dissect Calot's triangle among patients

		Extraction of Gall bladder				Chi-square (p-value)
		Difficult		Easy		
		Count	N %	Count	N %	
Gall Bladder size	Contracted	2	18.2%	2	4.3%	2.78 (0.249)
	Distended	1	9.1%	3	6.5%	
	Normal	8	72.7%	41	89.1%	
Number of stones	Multiple	10	90.9%	38	82.6%	0.46 (0.49)
	Single	1	9.1%	8	17.4%	
Size of stone >1cm	<1cm	7	63.6%	38	82.6%	1.93 (0.16)
	>1cm	4	36.4%	8	17.4%	
Pericholecystic fluid	Absent	10	90.9%	41	89.1%	0.03 (0.876)
	Present	1	9.1%	5	10.9%	
Aberrant Anatomy	Absent	11	100.0%	44	95.7%	0.49 (0.48)
	Present	0	0.0%	2	4.3%	
Gass in Gallbladder	Absent	10	90.9%	39	84.8%	0.27 (0.59)
	Present	1	9.1%	7	15.2%	
Liver mobility	Absent	3	27.3%	13	28.3%	0.04 (0.948)
	Present	8	72.7%	33	71.7%	
Common bile duct size >8mm	<8mm	5	45.5%	39	84.8%	7.79 (0.01)*
	>8mm	6	54.5%	7	15.2%	
Gallbladder wall thickness >4mm	<4mm	6	54.5%	40	87.0%	5.98 (0.01)*
	>4mm	5	45.5%	6	13.0%	
Stone impacted at GB neck	Absent	10	90.9%	40	87.0%	0.129 (0.720)
	Present	1	9.1%	6	13.0%	

On comparison of the USG findings with extraction of gall bladder, significant difficulty was present when the common bile duct size was >8mm and also in patients with gall bladder wall thickness of >4mm (Table 7).

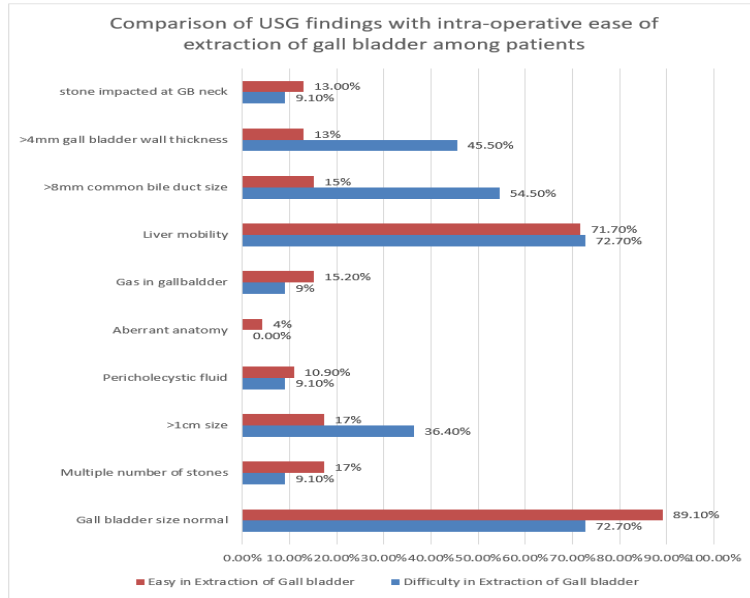
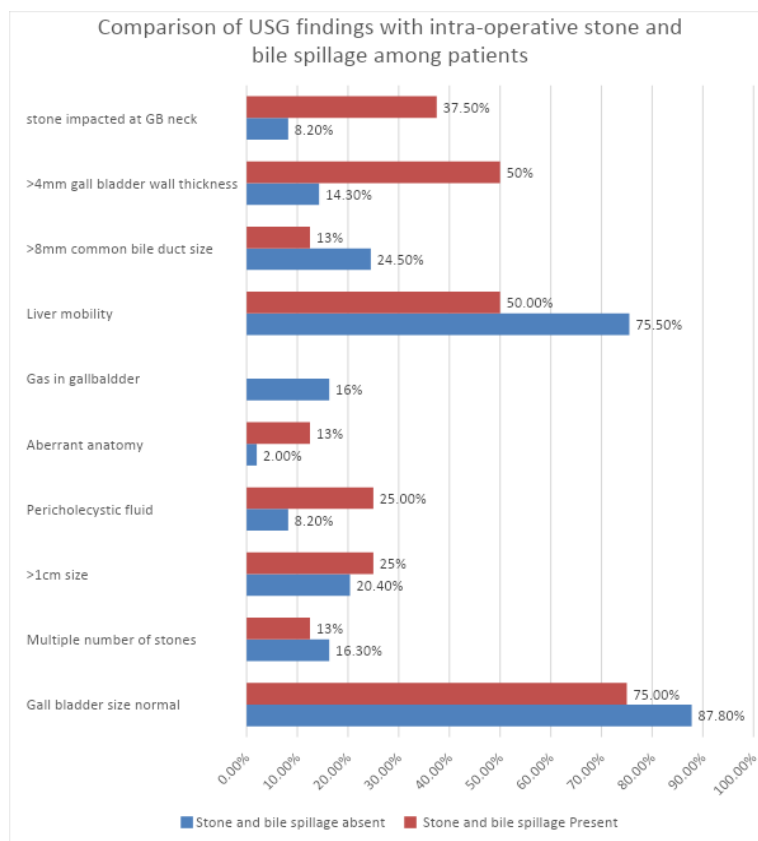


Figure 6: Comparison of USG findings with intra-operative ease of extraction of gall bladder among patients

		Stone and bile spillage				Chi-square (p-value)
		Absent		Present		
		Count	N %	Count	N %	
Gall Bladder size	Contracted	3	6.1%	1	12.5%	0.92 (0.62)
	Distended	3	6.1%	1	12.5%	
	Normal	43	87.8%	6	75.0%	
Number of stones	Multiple	41	83.7%	7	87.5%	0.076 (0.78)
	Single	8	16.3%	1	12.5%	
Size of stone >1cm	<1cm	39	79.6%	6	75.0%	0.87 (0.76)
	>1cm	10	20.4%	2	25.0%	
Pericholecystic fluid	Absent	45	91.8%	6	75.0%	2.07 (0.15)
	Present	4	8.2%	2	25.0%	
Aberrant Anatomy	Absent	48	98.0%	7	87.5%	2.22 (0.136)
	Present	1	2.0%	1	12.5%	
Gass in Gallbladder	Absent	41	83.7%	8	100.0%	1.51 (0.218)
	Present	8	16.3%	0	0.0%	
Liver mobility	Absent	12	24.5%	4	50.0%	2.217 (0.127)
	Present	37	75.5%	4	50.0%	
Common bile duct size	<8mm	37	75.5%	7	87.5%	0.563 (0.454)
	>8mm	12	24.5%	1	12.5%	
Gallbladder wall thickness	<4mm	42	85.7%	4	50.0%	0.562(0.01)*
	>4mm	7	14.3%	4	50.0%	
Stone impacted at GB neck	Absent	45	91.8%	5	62.5%	5.49 (0.01)*
	Present	4	8.2%	3	37.5%	

On comparison of the USG findings with stone and bile spillage, there was significant higher incidence in cases with gall bladder wall thickness of >4mm and when stone impacted at GB neck (Table 8).



**Figure 7: Comparison of USG findings with intra-operative stone and bile spillage among patients**

#### IV. Discussion

Laparoscopic cholecystectomy is a popular and less invasive technique for treating gallbladder disorders, particularly symptomatic cholelithiasis. It has several advantages over open surgery, such as less postoperative discomfort, shorter hospital stays, and faster recovery durations. But treatment might still provide considerable intraoperative complications, especially in individuals with severe gallbladder disease or anatomical differences.

In study by Chand P et al.,<sup>[5]</sup> the mean age of the patients was found to be 38.16yrs with 90% female and 10% male with female preponderance. 50 patients found that gallbladder wall thickness less than 4 mm predicted easy procedures in 38 out of 46 cases, with eight facing difficulties. All four patients with wall thickness greater than 4 mm encountered difficulties, yielding an 84% accuracy in predicting procedure difficulty based on wall thickness. Contraction of the gallbladder led to difficulties in all five cases, while among 45 patients without contraction, 38 procedures were easy, resulting in an 86% accuracy. Three patients with gallstones impacted at the neck experienced difficult procedures, compared to nine out of 47 patients with mobile stones, providing an 82% accuracy in predicting difficulty based on stone mobility. Another study by Togale V et al.,<sup>[6]</sup> the majority were more than 50yrs of age and 80% were female with female preponderance in the study.

Intra-operative findings correlated with these ultrasound parameters highlighted several challenges. Notably, a surgery duration exceeding 120 minutes was significantly associated with aberrant anatomy, a CBD size >8 mm, and a gallbladder wall thickness >4 mm. Difficulty in dissecting Calot's triangle for more than 20 minutes was significantly associated with a gallbladder wall thickness >4 mm. Similarly, a longer dissection time of the gallbladder bed was more likely in patients with multiple gallstones and a gallbladder wall thickness >4 mm.

Saad K et al. identified several factors associated with procedural difficulty, including hospitalization, previous supraumbilical surgeries, prior acute cholecystitis, episodes of jaundice, previous endoscopic biliary clearance, increased gallbladder wall thickness, and the presence of pericholecystic fluid collection.<sup>[7]</sup> Daly A et al.'s research found that 28% of anticipated challenging cases were verified as difficult, including 20 cases categorized as difficult, 2 as exceptionally difficult, and 6 as unexpectedly easy. Among those predicted to be exceptionally difficult (5% of cases), one was confirmed as such, one was straightforward, one was challenging, and three were highly difficult. The study established a strong statistical association between preoperative predictions and the actual difficulty encountered during laparoscopic cholecystectomy. The preoperative scoring system exhibited both statistical significance and clinical reliability in forecasting surgical outcomes.<sup>[8]</sup>



Complications such as gallbladder tear and bile spillage, observed in 14% of cases, were significantly more frequent in patients with a gallbladder wall thickness >4 mm and stones impacted at the gallbladder neck. Difficulty in gallbladder extraction was higher in cases with a CBD size >8 mm and a gallbladder wall thickness >4 mm.

Santharaj et al. emphasized that preoperative scoring of patients could preempt intraoperative challenges by predicting the likelihood of conversion to open cholecystectomy, enabling patients to be informed about this possibility before surgery.<sup>[9]</sup> In a study by Bhandari TR et al., difficult laparoscopic cholecystectomy (LC) was observed in 15.4% of cases, with an overall conversion rate of 8.9%. Logistic multivariable regression identified male gender, a history of acute cholecystitis, gallbladder wall thickness ( $\geq 4$ –5 mm), fibrotic gallbladder, and adhesions at Calot's triangle as independent predictors of difficult LC. These factors, including male gender, prior acute cholecystitis, thicker gallbladder walls, gallbladder fibrosis, and adhesions at Calot's triangle, are significant indicators of challenging LC. Awareness of these predictors can assist in treatment planning and resource allocation for effectively managing complex cases.<sup>[10]</sup>

Factors contributing to the elevated conversion rate in non-acute cases include dense adhesions and an oedematous gall bladder, which hinder exposure of Calot's triangle. Poor exposure may also result from dense, highly vascular adhesions, leading to bleeding and further compromising visualization. It's essential to note that most common bile duct injuries occur in scenarios where visualization is inadequate. Another study by Ali M et al., the conversion rate was found to be 3.8%.<sup>[11]</sup> In a subsequent study by Terho P et al., laparoscopic cholecystectomy resulted in a conversion to open surgery for 22.5% of patients. Factors such as elevated C-reactive protein levels, age over 65, diabetes, gallbladder gangrene, and abscess were identified as increasing the likelihood of conversion.<sup>[12]</sup> Significant correlations were identified between USG findings and surgical challenges: increased bleeding was linked to CBD size >8 mm and gallbladder wall thickness >4 mm. Extended surgery durations (>120 minutes) were more common with aberrant anatomy, CBD size >8 mm, and gallbladder wall thickness >4 mm.

## V. Conclusion:

This study results underscore the importance of ultrasound in detecting intraoperative challenges during laparoscopic cholecystectomy. Ultrasound parameters like gallbladder wall thickness, size of common bile duct and presence of multiple stones at the neck are important in anticipating surgical complexities and guiding treatment decisions.

### Funding: Nil

### Conflict of interest

There are no conflicts of interest

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