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Prediction Of The Difficulties Of LaparoscopicCholecystectomy And The Possibility Of Conversion To Open Cholecystectomy Before Surgery Using Ultrasonographic Criteria.

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ABSTRACT

Cholelithiasis, which is one of the most common digestive disorders encountered, was traditionally being dealt with by conventional or open cholecystectomy. With the introduction of laparoscopic cholecystectomy (LC), the surgical community witnessed a revolution in ideology and minimal access surgery gained tremendous popularity. To optimize the duration of surgery and provide better patient counseling on the basis of prior ultrasound findings. This prospective analysis of symptomatic gall bladder stone and prediction of ultrasonographic finding and its correlations with intra operative findings. Out of total 146 cases 34(23.3%) cases were converted to open procedure. Taking these values as reference, the minimum required sample size with desired precision of 17.5% and 5% level of significance is 97patients. All patients have been evaluated pre-operatively by ultrasound of abdomen. The pre operative criteria which were taken into consideration are given below. These criteria were then matched against certain intra operative criteria which are also given below. Each pre operative criteria was compared against an intra operative criteria and individual p values were calculated for each of them. All patients are subjected to Laparoscopic cholecystectomy after routine investigations and informed consent. Patients were also informed about the possibility of conversion to open cholecystectomy. In our study gall bladder wall thickness was significantly associated with duration of surgery > 120 mins, with increased intra operative bleeding, with increased time taken to dissect the Calots triangle, with increased duration to dissect the gall bladder bed, with difficulty in extraction of the gall bladder, with tear of gall bladder and spillage of bile and stones, and with an overall increased perception of difficulty intra operatively. Preoperative ultrasonography should be used as a screening procedure as it is a good predictor of difficulty in laparoscopic cholecystectomy in majority of the cases. It can help surgeon to get an idea of potential difficulty that he can face in the particular patient.

Keywords: Calot's triangle, difficult laparoscopic cholecystectomy, predictive factors, spillage of bile and stones, ultrasonography predictor

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INTRODUCTION

Cholelithiasis, which is one of the most common digestive disorders encountered, was traditionally being dealt with by conventional or open cholecystectomy [1]. With the introduction of laparoscopic cholecystectomy (LC), the surgical community witnessed a revolution in ideology and minimal access surgery gained tremendous popularity. In 1882, Karl Langenbuch performed the first open cholecystectomy for cholelithiasis [2]. The gold standard operative procedure today for dealing with cholelithiasis has become LC. Upwards of 80% of cholecystectomies are carried out laparoscopically nowadays [3]. Earlier return of bowel function, less postoperative pain, improved cosmesis, shorter length of hospital stays, earlier return to full activity and decreased overall cost are known advantages of laparoscopic cholecystectomy [4]. Patients with bleeding diathesis and carcinoma gallbladder are the only major contraindications of treating gall stone disease with laparoscopic procedure. In 1987, 105 years later, the first LC was performed by Philipe Mouret in Lyon, France In 1990, 10% of cholecystectomies were performed laparoscopically in the U.S and by 1992, this percentage had risen to 90%. Never before had a surgical revolution occurred so quickly [5]. According to recent studies, laparoscopic removal of gall bladder may be completed with morbidity and mortality comparable to or less than that of traditional open cholecystectomy when performed by an experienced laparoscopic surgeon.[6]Complications of LC are injuries to the (CBD) common bile duct, injury to bowel, bladder, aorta, iliac vessels and vena cava. These complications are more prone to happen if initial trocar is inserted blindly into the peritoneum [7]. Limitations of laparoscopy are costly equipment and unavailability of such equipment [8]. Ultrasonography remains the common screening test for cholecystitis and cholelithiasis because of the relative ease with which it can be performed, lack of ionizing radiation and ability to image the entire upper abdomen at the time of examination. Ultrasonography has been shown to have an accuracy of 96% in the diagnosis of gall bladder calculi [9]. The sensitivity with which ultrasonography can detect CBD calculi varies from 50% to 75%. Thus, a few preoperative ultrasonographic factors may help in the prediction of difficulties during LC. Appropriate planning to avoid complications and difficulties intra operatively for the benefit of patient and surgeon may be accomplished by a proper appreciation of these variables. Improved patient counseling, safety and post operativeexpectations are also obvious benefits of this [10].

MATERIALS AND METHODS

The study was conducted in the Department Of General Surgery, Government Kilpauk Medical College, Chennai, in the year 2017-2018.Tamil Nadu, India. This prospective analysis of symptomatic gall bladder stone and prediction of ultrasonographic finding and its correlations with intra operative findings at Assessment and Correlation of Technical Difficulties and Conversion to Open Procedure during Laparoscopic Cholecystectomy by Preoperative Ultrasonography was studied by Dr Parveen Garg. The study observed that the sensitivity and specificity of ultrasonography for predicting difficulties in surgery was 70.83% and 91.84% respectively and sensitivity of ultrasound to predict the conversion to open procedure was 76.47%, specificity was 85.71%. The total number of laparoscopic cholecystectomies attempted was 146 out of which 48(32.9%) were difficult on surgery. Out of total 146 cases 34(23.3%) cases were converted to open procedure. Taking these values as reference, the minimum required sample size with desired precision of 17.5% and 5% level of significance is 97patients.All patients have been evaluated pre-operatively by ultrasound of abdomen. The pre operative criteria which were taken into consideration are given below. These criteria were then matched against certain intra operative criteria which are also given below. Each pre operative criteria was compared against an intra operative criteria and individual p values were calculated for each of them. All patients are subjected to Laparoscopic cholecystectomy after routine investigations and informed consent. Patients were also informed about the possibility of conversion to open cholecystectomy.

Inclusion Criteria

All Patients of symptomatic gall stone disease reporting to Royapettah General Hospital, Chennai.

Exclusion Criteria

- Wt >90 kg.
- H/O >3 previous abdominal surgery.

- CBD dilated >10mm.
- CBD stone.
- Previous CBD exploration.
- Pancreatitis
- Denial of Consent
- Jaundice/ deranged LFT.

RESULTS

Table 1: Distribution Of Age Interval In Study Population

Age Interval	n	%
20 – 29	11	11.22%
30 – 39	17	17.35%
40 – 49	21	21.43%
50 – 59	24	24.49%
60 – 69	16	16.33%
70 – 80	9	9.18%
TOTAL	**98**	**100%**
Mean	49.08	
± SD	14.67	

Table 2: Intra-operative bleeding distribution in the study population

Intra-operative bleeding	n	%
Mild	94	95.92%
Moderate	4	4.08%
Severe	0	0.00%
TOTAL	**98**	**100%**

Table 3: Distribution of duration of surgery (in minutes) in studypopulation

Duration of surgery (in minutes)	n	%
< 120	78	79.59%
> 120	20	20.41%
TOTAL	**98**	**100%**

Table 4: Distribution of time to dissect gall bladder bed (in minutes) in thestudy population

Time to dissect gall bladder bed (in minutes)	n	%
< 20	72	75.78%
> 20	23	24.21%
TOTAL	**95**	**100%**

Table 5: Distribution of time to dissect calot's triangle (in minutes) in thestudy population

Time to dissect Calot's dissection (in minutes)	n	%
< 20	82	86.31%
> 20	13	13.69%
TOTAL	**95**	**100%**

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Table 6: Distribution Of Simple/Difficult Extraction Of Gall Bladder In TheStudy Population

Extraction of gall bladder	n	%
Simple	80	84.21%
Difficult	15	15.79%
TOTAL	**95**	**100%**

Table 7: Distribution Of Patients With/Without Tear Of Gall Bladder AndSpillage Of Stones And Bile

Tear of gall bladder and spillage of stones and bile	n	%
Yes	11	11.22%
No	87	88.78%
TOTAL	**98**	**100%**

Table 8: Distribution Of Gall Bladder Wall Thickness (In Mm) In TheStudy Population

Gall bladder wall thickness (in mm)	n	%
1. 5 -2	5	5.10%
2 - 2.5	20	20.41%
2.5 – 3	20	20.41%
3 - 3.5	22	22.45%
3.5 – 4	9	9.18%
4 - 4.5	10	10.20%
4.5 – 5	6	6.12%
5 - 5.5	3	3.06%
5.5 – 6	1	1.02%
6 - 6.5	2	2.04%
TOTAL	**98**	**100%**
Mean	3.19	
± SD	0.98	

Table 9: Association of intra-operative bleeding with ultrasonographicparameters.

Intra-operative bleeding →		Mild		Moderate		p-value
		n	%	n	%	
Gall bladder wall thickness (in mm)	< 4	77	81.91%	1	25.00%	
	> 4	17	18.09%	3	75.00%	0.006
Pericholecystic. fluid		8	8.51%	1	25.00%	0.263
Gall bladdersize	Normal	85	90.43%	1	25.00%	
	Distended	6	6.38%	0	0.00%	< 0.001
	Contracted	3	3.19%	3	75.00%	
	< 1	74	78.72%	3	75.00%	
Stone size (cm)						0.859
	> 1	20	21.28%	1	25.00%	
	Single	12	12.77%	0	0.00%	
no. of stone						1.000
	Multiple	82	87.23%	4	100.00%	
stone impacted at G B neck		8	8.51%	0	0.00%	1.000
Aberrant Anatomy		2	2.13%	0	0.00%	1.000
Gas in GB Wall		11	11.70%	0	0.00%	1.000
Common BileDuct Size (in mm)	< 8	76	80.85%	2	50.00%	
	>8	18	19.14%	2	50.00%	0.133
Liver	+	71	75.53%	3	75.00%	
Mobility	-	23	24.47%	1	25.00%	0.98
Prediction by	Simple	53	56.38%	1	25.00%	
						0.323

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ultrasonography	Difficult	41	43.62%	3	75.00%	

Table 9: 75% of patients with moderate intra operative bleeding had gall bladder wall thickness of >4mm and a contracted gall bladder, according to the above figure. This showed that the GB wall thickness was a statistically significant factor (p value 0.006 and < 0.001 respectively). According to the figure below, it was seen that 100% of patients with moderate bleeding had multiple calculi and 25% had stone size >1cm. No statistically significant association was found.

Table 10: Association Of Duration Of Surgery With UltrasonographicParameters

Duration of surgery (in mins) →		< 120		> 120		p-value
		n	%	n	%	
Gall bladder wall thickness (in mm)	< 4	72	92.31%	6	30.00%	< 0.001
	> 4	6	7.69%	14	70.00%	
Pericholecystic fluid		5	6.41%	4	20.00%	0.081
Gall bladder size	Normal	69	88.46%	17	85.00%	
	Distended	6	7.69%	0	0.00%	0.091
	Contracted	3	3.85%	3	15.00%	
Stone size (cm)	< 1	62	79.49%	15	75.00%	
	> 1	16	20.51%	5	25.00%	0.663
no. of stone	Single	11	14.10%	1	5.00%	
	Multiple	67	85.90%	19	95.00%	0.267
Stone impacted at gallbladder neck		4	5.13%	4	20.00%	0.030
Aberrant Anatomy		0	0.00%	2	10.00%	0.041

Table 10: 70% of patients with duration of surgery >120 minutes had gall bladder wall thickness >4 mm, according to the above figure. Association was found to be statistically significant (p value<.001).A significant association was found between duration of surgery and stone impacted at gall bladder neck (p-value 0.030) and also with aberrantanatomy (p-value 0.041).

Table 11: Association of time to dissect calot's triangle withultrasonographic parameters

Time to dissect Calot's triangle →		< 20		> 20		p-value
		n	%	n	%	
Gall bladder wall thickness (in mm)	< 4	73	90.12%	4	28.57%	< 0.001
	> 4	8	9.88%	10	71.43%	
Pericholecystic fluid		5	6.17%	4	28.57%	0.025
Gall bladdersize	Normal	71	87.65%	13	92.86%	0.553
	Distended	6	7.41%	0	0.00%	
	Contracted	4	4.94%	1	7.14%	
Stone size (cm)	< 1	64	79.01%	10	71.43%	0.503
	> 1	17	20.99%	4	28.57%	
No. of stone	Single	12	14.81%	0	0.00%	0.203
	Multiple	69	85.19%	14	100.00%	
Stone impacted at G B neck		5	6.17%	2	14.29%	0.274
Aberrant Anatomy		0	0.00%	0	0.00%	-
Gas in GB Wall		10	12.35%	0	0.00%	0.349
Common Bile DuctSize (in mm)	<8	70	87.5%	8	53.33%	
	>8	10	12.5%	7	46.67%	0.001
Liver	+	62	75.60%	10	76.92%	0.918
Mobility	-	20	24.40%	3	23.08%	
Prediction by	Simple	51	62.96%	3	21.43%	0.007

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ultrasonography		Difficult	30	37.04%	11	78.57%	

Table 11: Association of time to dissect calot's triangle with ultrasonographic parameters. A statistically significant association was observed between time to dissect Calot's triangle and: i Gall Bladder wall thickness (p-value< 0.001).ii. Pericholecystic fluid (p-value 0.025).A statistically significant association was seen between "Time to dissectcalot's triangle" and prediction by ultrasonography (p-value 0.007) and CBD size (p-value 0.001)

Table 12: Association of Extraction of Gall Bladder with ultrasonographic parameters

Extraction of Gall Bladder		Simple		Difficult		p-value
		n	%	n	%	
Gall bladder wall	< 4	69	87.34%	8	50.00%	
						0.001
thickness (in mm)	> 4	10	12.66%	8	50.00%	
Pericholecystic fluid		6	7.59%	3	18.75%	0.174
	Normal	72	91.14%	12	75.00%	
Gall bladder						
	Distended	4	5.06%	2	12.50%	0.176
size						
	Contracted	3	3.80%	2	12.50%	
	< 1	65	82.28%	9	56.25%	
Stone size (cm)						0.022
	> 1	14	17.72%	7	43.75%	
	Single	10	12.66%	2	12.50%	
no. of stone						1.000
	Multiple	69	87.34%	14	87.50%	
stone impacted at G B neck		5	6.33%	2	12.50%	0.335
Aberrant Anatomy		0	0.00%	0	0.00%	-
Gas in Gb Wall		8	10.13%	2	12.50%	0.674
Common BileDuct Size	<8	68	85%	10	66.66%	0.089
(in mm)	>8	12	15%	5	33.34%	
Liver	+	60	75%	12	80%	0.678
Mobility	-	20	25%	3	20%	
Prediction by	Simple	49	62.03%	5	31.25%	
ultrasonography	Difficult	30	37.97%	11	68.75%	0.023

Table 12: A statistically significant association was observed between "extraction of gall bladder" and Size of stone (p-value 0.022). A statistically significant association was observed between "Extraction of gall bladder" and Prediction of difficulty by ultrasonography (p-value0.023).

Table 13: Association of "Tear of gall bladder and spillage of stonesand bile" with ultrasonographic parameters.

Tear of gall bladder and spillage of stones and bile →		No		Yes		p-value
		n	%	n	%	
Gall bladder wall	< 4	73	83.91%	5	45.45%	0.003
thickness (in mm)	> 4	14	16.09%	6	54.55%	
Pericholecystic fluid		9	10.34%	0	0.00%	0.592
	Normal	77	88.51%	9	81.82%	
Gall bladdersize	Distended	6	6.90%	0	0.00%	0.153
	Contracted	4	4.60%	2	18.18%	
Stone size (cm)	< 1	67	77.01%	10	90.91%	0.448
	> 1	20	22.99%	1	9.09%	
No. of stone	Single	11	12.64%	1	9.09%	1.000
	Multiple	76	87.36%	10	90.91%	
Stone impacted at gallbladder neck		7	8.05%	1	9.09%	1.000

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Aberrant Anatomy		2	2.30%	0	0.00%	1.000
Gas in GB Wall		10	11.49%	1	9.09%	1.000
Common Bile Duct Size(inmm)	<8	69		8	66.66%	
	>8	17	80.23% 19.77%	4	33.34%	0.283
Liver Mobility	+	68	78.16%	6	54.54%	
	-	19	21.84%	5	45.46%	0.086
Prediction by ultrasonography	Simple	52	59.77%	2	18.18%	
	Difficult	35	40.23%	9	81.82%	0.011

Table 14: Association of operative Inference with ultrasonographicparameters

Operative Inference →		Easy		Difficult		
		n	%	n	%	P value
Gall bladder wall thickness (in mm)	< 4	72	85.71%	6	42.86%	0.001
	> 4	12	14.29%	8	57.14%	
Pericholecystic fluid		6	7.14%	3	21.43%	0.116
Gall bladder size	Normal	74	88.10%	12	85.71%	
	Distendedd	6	7.14%	0	0.00%	0.248
	Contracted	4	4.76%	2	14.29%	
Stone size (cm)	< 1	66	78.57%	11	78.57%	1
	> 1	18	21.43%	3	21.43%	
No. of stone	Single	11	13.10%	1	7.14%	1.000
	Multiple	73	86.90%	13	92.86%	
Stone impacted at gallbladderneck		5	5.95%	3	21.43%	0.043
Aberrant Anatomy		0	0.00%	2	14.29%	0.020
Gas in GB Wall		10	11.90%	1	7.14%	1.000
Common BileDuct Size (in mm)	<8	70	83.33%	8	57.14%	0.024
	>8	14	16.67%	6	42.86%	
Liver Mobility	+	68	85%	10	55.55%	0.005
	-	12	15%	8	44.45%	
Prediction by ultrasonography	Simple	51	60.71%	3	21.43%	0.008
	Difficult	33	39.29%	11	78.57%	

Prediction by ultrasonography	Sensitivity	Specificity	PPV	NPV	Diagnostic Accuracy
	78.57%	60.71 %	25.00%	94.44%	63.27%

DISCUSSION

Total number of cases in our study was 98. Maximum patients in our study were found to be in the age group of 50-59 yrs (24.49%). The mean age was 49.09 yrs and the vast majority of patients were females (81.63%).In this study, various parameters in pre operative ultrasonography were considered and correlated with intra operative findings and operative inference [11]. Out of 98 patients, a total of 94 patients(95.92%) had mild intra operative bleeding and 4(4.08%) had moderate intra operative bleeding. Severe bleeding was not seen intra operatively in any of our subjects [12]. On the basis of our study, it was seen that intra operative bleeding had a statistically significant association with gall bladder wall with thickness (p-value 0.006) and size of the gall bladder(p value< 0.001). Based on the findings by Nachnani et al in his study, it was found that bleeding occurred more often in patients with gall bladder wall thickness exceeding 3 mm.Out of a total of 98 patients, up to 80% had a duration of surgery less than 120 mins [13]. A statistically significant association was seen between duration of surgery and increase in gall bladder thickness (p value <0.001), with impaction of stone at the neck of the gall bladder (p value 0.030), with the presence of aberrant anatomy, Phyrgian cap (p value 0.041), CBD size (p value <0.001) and with prediction by ultrasonography (p value 0.001). In our study, different gall bladder morphology (i.e. phrygean cap) was seen in two patients and both were difficult during surgery. Around 4% of the population exhibit Phrygian cap, or pseudo-duplication of the gall bladder [14]. According to the findings of European surgeons, thickened gall bladder was associated with prolonged operative duration [15]. In our study, dissection of the gall bladder bed took <20 mins in 76% of our subjects. A statistically significant association was seen between time taken to dissect the gall bladder bed

and thickness of the wall of the gall bladder (p value<0.001), with gall bladder size(p value 0.008), with gas in the gall bladder wall (p value 0.046) and with prediction by ultrasonography(p value 0.014) [16]. Increased time was taken to dissect the gall bladder bed with increase in thickness of the gall bladder wall, with contraction in size of the gall bladder, with the presence of empyema or mucocoele [17]. A statistically significant association was observed between time taken to dissect Calots and gall bladder wall thickness (p value <0.001), with presence of pericholecystic fluid (p value 0.025), with CBD size (p value 0.001), and with prediction by ultrasonography (p value 0.007) [18]. In our study, extraction of the gall bladder was seen to be difficulty in 16% of the subjects. Difficulty in extraction refers to the necessity for extension of the port site, or for decompression of the gall bladder inorder to remove the specimen [19]. A statistically significant association was observed between time taken to extract the gall bladder and gall bladder wall thickness (p value 0.001), with size of the stones (p value 0.022) and with prediction by ultrasonography (p value 0.023). In our study, tear of the gall bladder and spillage of bile and stoneswas seen in 11% of our subjects [20]. As per our study, operative inference as simple or difficult had a statistically significant association with gall bladder wall thickness (p value 0.001), with impaction of stone at neck of the gall bladder (p value 0.043), with aberrant anatomy (p value 0.020), with CBD size (p value 0.024), with liver mobility (p value 0.005) and with prediction by ultrasonography (p value 0.008) [21]. Impaction of stone at the neck of the gall bladder makes operating tough because it becomes tough to hold the gall bladder. According to our study, one of the most important factors in a difficult laparoscopic cholecystectomy or the necessity to convert to open cholecystectomy was the presence of adhesions in the Calots triangle [22]. Presence of adhesions could lead to tear of the cystic artery, tear of the CBD or cause a tear in the gall bladder causing leakage of bile and stones [23]. In our study, tear in the CBD never occurred. And, bleeding was never a reason for conversion. In our study, 3 patients were converted to open cholecystectomy. No statistically significance was found for this. Conversion to OC in our study was 3.06% which turned out to be similar to the rates in other international studies [24,25].

CONCLUSION

At the conclusion of this study, it can be stated with confidence that pre operative ultrasonography is a good indicator of difficulties which may be faced intra operatively by the surgeon. Increase in gall bladder wallthickness, presence of impaction of stone at the neck of the gall bladder and aberrant morphology of the gall bladder and of the Calots triangle. It also helps us to plan out the surgery in advance and take consent and appraise the patient of the possible necessity for open cholecystectomy. The possible limitation of our study is due to the fact that, even though a sample size of 98 is considered substantial from a statistical point ofview, the number of difficult surgical cases was only 14, which is obviously small in comparison. A larger sample size could have given usa better indicator of PPV probably.

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