IOSR Journal of Dental and Medical Sciences (IOSR-JDMS)
e-ISSN: 2279-0853, p-ISSN: 2279-0861.Volume 18, Issue 6 Ser. 6 (June. 2019), PP 32-42
www.iosrjournals.org

A Prospective Study toDetermine Preoperative and Intra Operative Factors Requiring Conversion of Laparoscopic Cholecystectomyto Open Cholecystectomy

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Abstract
Objectives*-To determine the pre operative factors based on clinical,laboratory and radiological parameters which leads to conversion of laparoscopic cholecystectomy to opencholecystectomy.To determine intra operative factors based on laparoscopic findings that leads to conversion of laparoscopic cholecystectomy to open cholecystectomy.*
Aims*-To identify difficult dissection by clinical, laboratory and radiological parameters in laparoscopic cholecystectomy.*
Methodology*- All patients undergoing consecutive cholecystectomy were included in this study. Patients meeting the exclusion criteria were not included in the study. Clinical, laboratory and radiological parameters were analysed for significant correlation with the outcome of the surgery to predict difficult dissection during cholecystectomy.*
Conclusion*-Difficult dissection in cholecystectomy can be predicted using pre-operative parameters.*
Keywords*-GB-Gallbladder,CBD-Commonbile duct,EHC-Enterohepaticcirculation,BMI-Body massindex, LFT-Liver function test*

Date of Submission: 26-05-2019 Date of acceptance: 11-06-2019

I. Introduction

Gallstones are among one of the most common diseases affecting the digestive system requiring hospitalization with a prevalence of 11% to 36% inautopsy report[1]. However most patients remain asymptomatic (>80%) and they have <20% chance of ever developing symptoms and the risk of prophylactic cholecystectomy outweighs the potential benefit of surgery inmost patients[2]. Gallstone disease prevalence in general population is 3% to 20% ofthe total population worldwide[3]. The prevalence of gallstones varies widely in different parts of the world. It is more common in developed countries. InIndia, it is estimated to be around 6%[4.] An epidemiological study done on rail road workersrevealed that northIndians has 7 times higher incidence ofgallstones compared to South Indians[5]. Laparoscopic cholecystectomy has now become widely accepted as the procedure of choice and with their growing experience surgeons have started taking up even more complex cases and high risk patients.So, it is with this wider application of laparoscopy for technically difficult and high risk patients, it is expected that the complication rates would rise as would rate of conversion to open cholecystectomy. In about 5% to 12% of laparoscopic cholecystectomy, conversion to open method may be needed forvarious reasons[6-12]. But irrespective of this, morbidity and mortality statistics still do favor laparoscopic cholecystectomy over open. Difficulties in accessing the peritoneal cavity, creating a pneumoperitoneum, dissecting the gallbladder or extracting the excised gallbladder are other problems that render difficulty during laparoscopy and conversion to an open cholecystectomy may be required. It is important to note that conversion is neither a failure nor a complication, but an attempt to avoid complication and ensure patient safety.Patients undergoing open cholecystectomy as a planned procedure, either due to contraindications to laparoscopy or surgeons inexperience or surgeons judgement based on severity of the pathology and may also encounter difficulty in dissection due to various reasons such as dense adhesions, frozen Calot's triangle, aberrations in the anatomy of cystic duct often requiring the fundus first technique or subtotal cholecystectomy.It cannot be said with certainty preoperatively whether the cholecystectomy is going to be easy or difficult. So, in order to reduce the conversion rates, surgeons need to be able to know preoperatively the scale of difficulty of the surgery so that they can be better prepared.This study has tried to look at various parameters pre-operatively that would help a surgeon predict a "difficult cholecystectomy" both in laparoscopy

and open methods. Various variables are studied, in patients undergoing consecutive cholecystectomies (both open and laparoscopic) for gallstone related disorders, to predict the difficulties encountered during the surgery.

II. Methodology

Study design: This is a prospective, observational, single center study
Study place: Department of General Surgery, S.V.R.R.G.G. Hospital,Tirupati.
Study period: The data collection was done from the period of August2016 to November 2017.
Inclusion Criteria:All patients undergoing consecutive cholecystectomy for cholelithiasis and its related complications in S.V.R.R.G.G. Hospital.

Exclusion Criteria:
Gall stone with CBD stone.
Age factor <13yrs.
Cirrhotic patients.
Previous multiple upper abdominal surgeries.
Abnormal coagulation profile.
Patient undergoing cholecystectomy for non-gallstone related diseases.

Ethical Considerations:Institutional review board of research studies and Independent Ethics Committee (IEC) Reg. No. M150110007 reviewed this study protocol and ethical clearance was obtained. Informed written consent was obtained from all the study participants after thoroughly explaining the study protocol, benefits and risks. Confidentiality of the study participants was maintained throughout the study

Clinical Parameters: Age- taken as a continuous variable and later grouped as <50yrs and >50yrs,Gender,BMI- taken as a continuous variable and then later grouped as normal (<25kg/m^2), overweight (25-30kg/m^2) and obese (>30kg/m^2)Presence of concurrent medical illness like diabetes mellitus, hypertension, bronchial asthma, heart disease, History of any intra-abdominal surgery, History of symptoms namely- pain abdomen, fever, dyspepsia, vomiting.Patients with acute cholecystitis is defined as those patients with right upper quadrant pain showing evidence of Murphy's sign on physical examination and pericholecystic fluid collection on imaging with or without constitutional symptoms, requiring emergency admission.

Laboratory Parameters:
Total white cell count- is taken as a continuous variable and then categorized as normal or elevated. (normal- <11,000/cu.mm and elevated- >11,000/cu.mm)
Liver function test:
Serum bilirubin- values above 1.2mg/dl is considered elevated.
Serum transaminases- SGOT>40U/L or SGPT>40U/L isconsidered as elevated.
Serum ALP/GGT- ALP>200U/L or GGT>50U/L is considered as elevated

Imaging Parameters: All patients underwent USG abdomen and ware diagnosed to have cholelithiasis. The following data in the scan was evaluated for:
Number of stones: single or multiple or presence of sludge
Size of the stones: <1cm or >1cm
Gallbladder wall thickness: <3mm or >3mm
CBD diameter: <8 mm or >8 mm
Presence of stone impaction or not in the neck of gallbladder, cystic duct or Hartmann's pouch.
Presence of pericholecystic fluid or not.

Dependent Variables: The following outcomes during surgery were taken as the dependent variables.
Duration of surgery (in minutes): in patients undergoing laparoscopy, the duration included time- from insertion of veress needle in closed technique or insertion of port in open technique to extraction of gallbladder; and in patients undergoing open cholecystectomy, the duration included time- from skin incision to extraction of gallbladder.
Pericholecystic fluid: presence of free fluid- clear or purulent- in the pericholecystic, peri-hepatic, and sub hepatic space.
Adhesion: presence of adhesions between the gallbladder and the adjacent organs (transverse colon, duodenum, omentum). Adhesions were graded as none, flimsy or dense based on the ease of removal of the adhesions.

Gallbladder wall thickness: after gallbladder extraction, the gallbladder was opened and the gallbladder wall thickness was measured quantitatively using Verniercallipers at the thickest portion of the gallbladder grossly visible.

Bile leak/stone spill: during surgery, accidental puncture of the gallbladder wall leading to bile leak or spillage of stones indicating inflammation and friability of the wall.

Calot's triangle identification: difficulty in identification of Calot's triangle structures and requiring more than 20 minutes of dissection was defined as difficult.

Gallbladder bed dissection: was defined as easy or difficult by the operating surgeon.
Implementation of fundus first technique or a subtotal cholecystectomy indicates difficulty in dissection of Calot's and hence was considered as difficult.

All patients were given a trial of laparoscopic attempt unless if the surgeon by his experience anticipated difficulty during dissection and decided to do an open surgery directly keeping in mind the safety of the patient.

Complications of cholelithiasis like mucocele, empyema, perforation, gangrenous gallbladder or Mirizzi's syndrome will lead to more difficulty during surgery. There will be more inflammation, friable tissues, inability to grasp the gallbladder and difficult identification of structures.

Operative Technique;

The standard four port technique was used for all laparoscopic cholecystectomies. First, a 10-mm port was inserted in the umbilical region using veress needle or under vision. Other ports included a 10-mm port to the epigastrium and two 5-mm lateral ports. Dissection of the Calot's triangle was done using Maryland forceps and either electrocautery or harmonic. Cystic duct and cystic artery were identified and clipped separately and cut. Gallbladder removal from the bed was accomplished by using either monopolar cautery or harmonic ultrasonic energy and extracted through the epigastric port with or without a bag. When conversion was required, a Kocher's incision was made and cholecystectomy was completed. Decision for conversion was made based on the surgeon's intra-operative judgement. For open cholecystectomy, a Kocher's incision was made in the right hypochondrium. Gallbladder was held using a sponge holder; bowels kept away medially using abdominal packs. Calot's triangle identified, cystic duct and artery identified and ligated separately using silk and cut. Gallbladder dissected from the liver bed using monopolar cautery.

Table-1: Scoring Factors-Clinical Parameters

	Score	Maximum
Age in years	<50(0) >50(1)	1
Gender	Female(0) Male(1)	1
BMI (kg/m^2)	Normal (<25.5)(0) Overweight (25-30)(1) Obese (>30)(2)	2
Previous intraabdominal surgery	No(0) Yes (1)	1
Diabetes mellitus	No(0) Yes(1)	1
Pain	No h/o pain (0) Past h/o pain, but no at present(1) Present pain but no h/o pain in the past(2) h/o pain in the present and past	3
Duration of pain in days	<3(0) ≥3(1)	1
Fever	No (0) Yes(1)	1
Murphy's sign	No(0) Yes(1)	1
Total		12

Table -2: Scoring Factors- Laboratory Parameters:

	Score	**Maximum score**
Total White Cell count (in cumm)	<11,000 (0) >11,000 (1)	1
Serum bilirubin (in mg/dL)	<1.3 (0) >=1.3 (1)	1

Serum transaminases (in IU/L)	Normal (0) Elevated (1)	1
Serum ALP/ GGT (in IU/L)	Normal (0) Elevated (1)	1
TOTAL		4

Table -3: coring Factors- Imaging Parameters:

	Score	**Maximum score**
Number of stones	Single (0) Multiple (1)	1
Size of stones (in cm)	<1 (0) >1 (1)	1
GB wall thickness (in mm)	<3 (0) >3 (1)	1
CBD diameter (in mm)	<8 (0) >8 (1)	1
Stone impaction	No (0) Yes (1)	1
Pericholecystic fluid	No (0) Yes (1)	1
TOTAL		6

Table-4: Score for Intra- Operative Findings

Findings	Score	Maximum score
Duration	<60min(0) >60min(1)	**1**
Pericholecystic fluid	No (0) Yes (1)	**1**
Gallbladder wall thickness	<3mm(0) >3mm(1)	**1**
Adhesions	None (0) Flimsy (1) Dense(2)	**2**
Bile leak/stone spill	N0 (0) Yes (1)	**1**
Calot's triangle identification	Easy (0) Difficult(1)	**1**
Subtotal cholecystectomy or Fundus first technique	N0 (0) Yes (1)	**1**
Conversion to open/direct opencholecystectomy	N0 (0) Yes (1)	**1**
Presence Of complications	Mucocele(1) Empyema gallbladder(2) Gallbladder perforation(3) Gangrenous gallbladder(4) Mirizzi's syndrome(5)	**5**
Total		**14**

Total Score: 15: Easy 0-5: Difficult: 6-10; Very Difficult:11-15

Scores were given based on history, clinical examination, laboratory investigations and imaging findings according to the TABLES 1 to 3. Maximum score given was 12+4+6=22. Scores up to 8 was defined as easy, between 9 and 15 was defined as moderate and scores more than 16 was defined as difficult. For statistical analysis, only two groups were considered-easy (scores <8) and difficult (scores >9).

Intra-operative outcomes were also scored as given in TABLE NO 4. Maximum score was 15. Scores below 5 was considered easy, between 6 and 10 was considered as difficult, and scores above 11 was taken as very difficult. Similarly, for statistical reasons, only two groups were taken easy (score <5) and difficult (score >6).

Statistical analysis:

Descriptive analysis of all the independent and dependent variables were done. All the parameters were described as categorical variables and were presented in percentages. The association between the pre-operative parameters and the outcome parameters was assessed using chi-square test. Graphical representation of analysis is also presented in an appropriate way and used to assess the predictive values of difficult dissection during cholecystectomy by using a pre-operative score.

III. Results

Table-5: Demographic Data of the Study Population

		Frequency	Percentage (%)
Age (in years)	<50	40	50
	>50	40	50
Gender	Male	26	32.5
	Female	54	67.5
BMI (kg/m^2)	Normal	32	40
	Overweight	28	35
	Obese	20	25

In this study, half of the population was below 50 years 40/80, and half of them were more than 50 years.Majority of the study population were females, 54/80 (67.5%) and 26/80 (32.5%) were males.In this study population,32 out of 80 (40%) had BMI within normalrange (<25kg/m^2) and around 60% had elevated BMI, which includes 28/80(35%) in the overweight group (25kg/m^2 to 30 kg/m^2) and 20/80 (25%) in theobese group (>30kg/m^2).

Table - 6: Clinical Presentation of the Study Population

		Frequency	Percentage (%)
Pain	yes	67	83.75
	no	13	16.25
Fever	Yes	19	23.7
	No	61	76.3
Murphy's sign	Yes	16	20
	No	64	80

Most of the patients presented with combination of symptoms. The above table shows the frequencies of each symptom in the study population. 19/80 patients (23.7%) presented with complaints of fever and 61/80 are without fever(76.3%).

Table -7: Per-Operative Outcome of the Study Population;

		Frequency	Percentage (%)
Duration (in min)	<60	31	38.8
	>60	49	61.2
Pericholecystic fluid	Yes	15	18.75
	No	64	81.25
GB wall thickness (in mm)	<3	46	57.5

	>3	34	42.5
Adhesions	None	30	37.5
	Flimsy	28	35
	Dense	22	27.5
Bile leak/ Stone spill	Yes	11	23.8
	No	69	76.2
Calot's triangle identification	Easy	64	80
	Difficult	16	20
Sub-total cholecystectomy	Yes	7	8.8
	No	73	91.2
Fundus first technique	Yes	13	16.2
	No	67	83.8

The above table shows the distribution of the intra- operative findingsamong the study grow up in terms of frequency and percentage.

Table -8: Distribution of Patients in the Intra-Operative Outcome Groups

Easy (0-5)	Difficult (6-10)	Very difficult (11-15)
55(68.75%)	19(23.75%)	6(7.5%)

There were 55patients (68.75%) in the easy group with a score ranging from 0 to 5. There were 19 patients (23.75%) in the difficult group with score ranging from 6 to 1 0. There were 6 patients (7.5%) in the very difficult group with scores from 11 to 15. For statistical analysis, difficult and very difficult groups were combined as one group with 25 patients.

Tables Showing Association between Pre-Operative Parameters and Operative Outcome

Table-9: Association between Demographic Data and Per-Operative Outcome

		Intraoperative		**Total**	**p-value**
		Easy	**Difficult**		
Age(in years)	<50	34	6	40	0.001
	>50	21	19	40	
Gender	Female	41	13	54	0.04
	Male	14	12	26	
BMI	<25	23	9	32	0.62
	25-30	18	10	28	
	>30	14	6	20	
Diabetes Mellitus	No	42	16	58	0.25
	Yes	13	9	22	

Chi-square test: P significant at 0.05.

Of the 25 patients who had difficult cholecystectomy, only 6(24%) were in the age group of <50 years and 34(76%) were in the age group of >50 years.
Among the females patients, 13 out of 54 (24.07%) had difficult surgery whereas
among the male patients, 12 out of 26 (46.15%) had difficult cholecystectomy.
Of the patients who had difficult surgery, only 9/25 (36%) had diabetes and among diabetics, 13/25 patients (53%) had easy surgery.

Table -10: Association between Pain Duration and Intra-Operative Outcome

Pain duration (days)	Intra-op findings		Total	P-value
	Easy	Difficult		
<3	24	16	40	0.65
>3	17	9	26	
Total	41	25	66	

Chi-square test: P significant at 0.05.

Out of 66patients who came with the complaints of present pain, had difficult surgeries.9/25 patients (37%) had pain for more than 3 days and 16/25 patients
(63%) had pain for less than 3 days.

Table - 11: Association of Clinical Signs of Inflammation with Intra-Operative Findings

		Intra-op findings		Total	P value
		Easy	Difficult		
Fever	No	46	15	61	0.02
	Yes	9	10	19	
Murphy's sign	No	52	12	64	0.001
	Yes	3	13	16	

Chi-square test: P significant at 0.05.

Of the 25 patients who had difficult surgeries, 10 patients had fever(40%).
16 patients in the current study had Murphy's sign positive on physical examination. 13 of them had difficult surgery (81.25%).

Table -12: Correlation of Pre-operative Score with the Intra-operative Score.

Pre-operative score	Intra-operative score		Sensitivity %	Specificity %	PPV %	NPV %
	Easy	Difficult				
<=8	39	5	71%	80%	88%	55%
>8	16	20				
Total	55	25				

Pre-operative scores were given based on history, clinical examination, laboratory investigations and imaging findings as per TABLE NO 1-3. Scores of 8 or below was considered easy and scores of 9 or above was considered difficult. Taking 8 as the cut off value for pre-operative score, the sensitivity and specificity for predicting the intra-operative outcome was at 71% and 80% respectively. The positive predictive value for easy prediction was 88% and for difficult prediction was 55%.

IV. Discussion

Laparoscopic cholecystectomy is now widely accepted as the procedure of choice for symptomatic gallstone disease. In high risk patients and in complex cases having technical difficulty, the complication rates and the conversionrates increases. The accepted conversion rate worldwide is 2% - 15%[6-12] and the incidence of bile duct injury is 0 - 0.6%. Irrespective of the morbidity involved, statistics still favour laparoscopic cholecystectomy over open cholecystectomy.It is important to identify and predict a difficult cholecystectomy pre-operatively which is essentially the same in laparoscopy as well as in open method increasing the complexity of a conventional surgery. Pre-operative prediction of a difficult cholecystectomy not only helps patient counseling but also helps the surgeon to prepare better for the intra-operative risk and the technical difficulties expected to be encountered. Present study consists of 80 patients who are known case of cholelithiasis admitted for surgery. Intra-operatively, the outcome/ findings were noted and scored as per TABLE NO 4. Minimum score given was 0 and maximum score given was 15. Scores less than 5 was considered easy, 6 to 10 considered as difficult and 11 to 15 was taken as very difficult. For analysis, 2 groups were created- Easy (scores <5) and Difficult (scores >6). Various pre-operative factors including demographic, clinical, laboratory andimaging parameters were taken and compared with the two intra-operative groups to look for association.TABLE NO 5 shows age and gender variations in the present study. The incidence of cholelithiasis in the present study was most common in theage group of 30 to 50. Randhawa et al[17] in their study also reported highest incidence in the age group between 30 and 50 and making their total number comparable to the present study.Thus, 50 years was selected as the cut off to assess the implication of advancing age in predicting difficult cholecystectomy. There was equal distribution of patients in the two groups in the current study.There were 14 patients in the age group of > 65 years, which was 18%.Kauvar et al[21] showed in their study that number of patients above 65 years was 59 (out of 315) which was 19% and comparable with the present study.67.5% (54/80) were females and 32.5% (26/80) were males in thecurrent study. Oymaciet al[15] had incidence of 68% of females which was comparable to this study. women are affected most commonly and at earlier age than men. This is probably because of the hormone estrogen influence causing gallbladder stasis, pregnancy and multiparity of female patients.TABLE NO 5 shows that total 40% were with normal BMI, 35% were overweight and 25% were obese. Majority of the patients in the study were inthe normal weight category which is in contrast to study by Gabriel et al[20]who reported that most of the patients (58%) had normal BMI and 42% had abnormal BMI which included 38% in the overweight group and 4% in the obese group.

TABLE NO 6 shows the distribution of clinical presentation in the study population. The most common complaint was upper abdominal pain in 67 patients (83.75%) followed by 19 patients had fever (23.7%).TABLE NO 6 shows the details of pain. Of the 67(83.75%) patients withcomplaints of pain. In the study by Gabriel et al[20], there were 209 patients with complaints of biliary colic (89%) and 102 patients had right upper quadrant pain at the time of presentation which is comparable to the present study.This shows that pain was the most alarming factor for which most patients decided to seek medical attention. The shorter duration of pain from the time of onset to the time of admission indicates that the study population is more health conscious and probably awareness of gallstone disease is more in the urban area.Of the 67 patients presenting with right upper quadrant pain, 16 of them had positive Murphy's sign. Patients with right upper quadrant pain showing evidence of positive Murphy's sign on physical examination and pericholecystic fluid collection on imaging, requiring emergency admission and 12 had elevated total white cell counts.Most patients with gallstones are asymptomatic. Of such patients, biliary colic develops in 1 to 4% annually and acute cholecystitis eventually develops in about 20% of these symptomatic patients if they are not treated. This is comparable to the present study wherein, 19.4% of the study population had acute cholecystitis.Lakatoset al[23] study tried to determine a precise and easily applicable clinical, biochemical and ultrasound selection criteria for patients who should undergo further investigation of the biliary tree before surgery to identify those with common bile duct stones. The positive predictive value of laboratory data for common bile duct stones was 60-73.3% and for ultrasound was 73.1%.In the present study, altered LFT showed poor PPV and reasonably good sensitivity. Hyperbilirubinemia had a PPV of 28.1%, elevated liver enzymes had PPV of 24% and sensitivity of 76%. The low positive predictive value is probably due to the false positives as in viral hepatitis or drug induced hepatitis and the high sensitivity indicates the inflammation of the common bile duct associated with stones.

In this study, of the 80 laparoscopic cholecystectomies, 71 were completed successfully by laparoscopic method and 9 cases required conversion to open method. The conversion rate of the current study was 11.25%. The accepted conversion rate worldwide is around 2% to 15%.[3,6-12,19.]

Table -13: Reasons for Conversion:

Frozen calot's triangle	3
Adhesion	2
Gall bladder perforation	2
Inflamed,gangrenous gallbladder	1
Equipment failure	1

In acute cholecystitis, the conversion rate is higher, ranging between 20% to 40%.[13-16]

This is probably because of several reasons- difficulty in holding the gallbladder due to inflammation and friability of the gallbladder wall; dense inflammatory adhesions to the surrounding structures like duodenum, colon; inflammatory infiltrate into the components of the Calot's triangle thereby making identification of cystic duct and its junction with common bile duct difficult.In view of patient safety and to avoid complications, surgeons prefer to convert to open method in case of any doubt in identification of structures or if they encounter difficulty in dissection.in this study 9 cases are required conversion to open cholecystectomy.

TABLE NO 7 shows the distribution of the intra-operative findings in the study population.The average time duration taken was 60 min. The minimum time taken was 37min. 38.8% had duration <60 min and 61.2 had duration >60 min.18.75% of the patients had pericholecystic fluid as an intra-operative finding.

The gallbladder wall thickness was as measured by Verniercalliper. The minimum thickness recorded was 1mm and the maximum thickness was 5mm. Taking 3 mm as the cut off value, 57.7% had normal gallbladder wallthickness and 42.3% had thickness >3mm. Similarly Rosen et al[10]showed32.8% and Nachnani et al[8] showed 30.5% having thickened gallbladder wall.Adhesions to the gallbladder were noted in 62.5% of the patients, which was graded as flimsy in 28 patients and dense in 22 patients. 30 patients (37.5%) had no adhesions.Intra-operative bile leak from the gallbladder or spillage of stone into the peritoneal cavity was noted in 11 patients (23.8%). All the stones spilled out were extracted using forceps. In certain difficult cases, gallbladder was opened up electively for ease of dissection.

Difficult identification of Calot's triangle intra-operatively was encountered in 16 patients (20%). Difficulty in identification of cystic duct was the most common reason for conversion in this study. Difficulty could be due to inflammatory infiltrate, anatomical variation or dense adhesion in the Calot'straingle.

Difficulty in gallbladder dissection from liver bed was seen in12 patients (15%). 2 patients had continuous oozing from liver surface during gallbladder bed dissection prolonging the dissection time. However, both the cases were completed laparoscopically and bleeding was arrested by compression.8 patients (10%) required subtotal cholecystectomy and 13 patients (16.2%) required fundus first technique. This was employed when there was frozen Calot's so as to prevent injury to common bile duct and ensure patient safety.

TABLE NO 8show the number of patients in each group of the intra-operative outcome. 55 patients (68.75%) were in the easy group, 19 patients (23.75%) had difficult surgery and 6 patients (7.5%) were in the very difficult group.

TABLES 9 to 12 show the association of the various pre-operative parameters with the intra-operative outcome and their significance.

Demographic Parameters

Age is recognised as a risk factor for difficult cholecystectomy andconversion.[12,18,] This is probably because of the longer duration of the gallbladder disease with more episodes of acute attack causing fibroticadhesions. Kauvaret al[21] found age >65 years to be strongly associated withdifficult cholecystectomy. Brodsky et al[16] identified age >60year s to be associated with conversion in acute cholecystitis.

In the present study, 50 years was taken as the cut off and was found to be significantly associated with difficult cholecystectomy (**p=0.001**) which is shown in TABLE NO 12. However, Randhawaet al[17] did not find any association with age > 50 and difficult surgery. Several other studies did notfind any correlation with age.[6,10,11] This varied opinion could be attributed to the surgeon's experience and expertise.Various studies have reported male sex to be a risk factor for difficultcholecystectomy.[8,12,20] The exact reason for male patients to be associated with higher risk is not very well known. Male patients usually are found to have more intense inflammation and fibrosis, resulting in more difficult dissection in the Calot's triangle and through the plane between gallbladder and the liver. A possible explanation for this is that males have a higher threshold for pain, and it is probable that they have experienced many recurrent silent attacks of acute cholecysytitis which predisposes them to a more severe form of inflammation at the time of presentation.

TABLE NO 9 in the present study shows that males were found to be significantly associated with difficult surgery (**p=0.04**).Obesity as a risk factor for difficult cholecystectomy is ambiguous. Obese patients can have technical difficulties like thick abdominal wall, cannula displacement, difficulty in obtaining pneumoperitoneum, fat laden falciform ligament and omentum, heavy fatty liver which will be difficult to elevate. Few studies have reported significance between higher BMI andconversion.[8,1820,24]Rosen et al[7]reported that BMI >30kg/m2 independently predictedconversion in patients with acute cholecystitis. Kumar et al[10] also found a significant association between high BMI and conversion (p=0.003).

Conversion among patients with low BMI <30kg/m2 was 4.8% and among patients with BMI >30kg/m2 was 14.63%.n the present study, there was no statistical significance between higher BMI and difficult surgery (**p=0.62**) as shown in TABLE NO 9.

Comorbid Conditions

It is known that diabetic patients have flaccid, poorly emptying gallbladders referred to as *diabetic neurogenic gallbladder*. In diabetic patients, there will be stasis of bile, and also there may be several attacks of sub acute inflammation not perceived by the patient due to diabetic autonomic neuropathy. This will cause more scarring making cholecystectomy moredifficult. However Kanaanet al[25] did not find any association between diabetic patients and difficult cholecystectomy or conversion.Similarly, this study also did not find any similar correlation between patients with diabetes mellitus and difficult cholecystectomy, **p=0.25**.

Clinical Parameters:

Pain is an important factor indicating the severity of the gallbladder disease. Pain could be as a result of stone obstructing the cystic duct or neck of gallbladder or due to the inflammatory process. Long standing pain indicates recurrent attacks of infection/obstruction thereby increasing the fibrosis and gallbladder thickness.Sanabria et al[22] reported that attacks more than 10 was significantlyassociated with conversion whereas Kumar et al[10] found association with difficult surgery with more than 5 attacks of pain in the past, p=0.001. History of acute cholecystitis was also significantly associated with higher risk of conversion[6,8,10].The association of duration of pain and difficult cholecystectomy is shown in TABLE NO 10. Only patients presenting with pain was considered and was divided into <3 days and >3 days and it was not found to be statistically significant, **p=0.65**. This may be because most patients presenting with pain predominantly had biliary colic than due to inflammation.TABLE NO 14 shows clinical signs of inflammation. Fever, tenderness in right hypochondrium indicates presence of ongoing/persisting inflammation with oedema of gallbladder making surgery difficult. Fever and righthypochondrium tenderness as a risk factor was identified in several series.[6,11]Kumar et al[10] reported that conversion rate was also significantly higher in patients with history of fever (17.46% vs. 4.66%) and tenderness in the right hypochondrium at presentation (36% vs. 4.8%).Similarly in the current study, fever**(p valve=0.02)** and positive Murphy's sign**(p valve=0.001)** was statistically significant and associated with difficult cholecystectomy.

Table - 14: Comparison of Sensitivity and Specificity of Pre-Operative Score with Previous Papers

	PPV easy %	**PPV difficult %**	**Sensitivity %**	**Specificity %**	**Cut off score**
Randhawa et al[52]	88	92.2	75	90	5
Gupta et al[74]	90	88	95.74	73.68	-
Dhanke et al[70]	94	100	-	-	-
Vivek et al[53]			85	97.8	9
Present study	88	55	71	80	8

The above table shows previous studies comparison of sensitivity, specificity, positive predictive value for easy and difficult prediction with the present study. As the score increases, the difficulty level increases. Kama etal[26], reported that patients who required conversion had significantly higher scores (mean=6.9) and increasing scores resulted with significant increases in conversion rates and probabilities (p <0.001).

V. Conclusion

Difficult dissection in cholecystectomy can be predicted using pre-operative parameters.

Among demographic variables- Increasing age (>50 years) and male gender was significantly associated with difficult surgery.

Clinically, patients presenting with pain at the time of admission or patients with multiple attacks in the past had a higher proportion of difficult cholecystectomy.

Patients with Fever, Positive Murphy's tenderness and elevated Total white cell count indicating inflammation of the gallbladder had higher risk for difficult surgery

Among the radiological parameters, irrespective of the number and size of the stones, gallbladder wall thickness >3mm, and presence of Pericholecystic fluid had strong association with difficult cholecystectomy.

The pre-operative scoring system devised in the current study, can be used to help in the prediction of the intra-operative outcome. This scoring system needs to be validated by further multi-centre trials before it can be implemented in routine clinical practice

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Dr Ma Haribabu. "A Prospective Study to Determine Preoperative and Intra Operative Factors Requiring Conversion of Laparoscopic Cholecystectomy to Open Cholecystectomy". IOSR Journal of Dental and Medical Sciences (IOSR-JDMS), vol. 18, no. 6, 2019, pp32-42.