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Original Research Article

Preoperative predictors of a difficult laparoscopic cholecystectomy

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ABSTRACT

Background: Laparoscopic cholecystectomy (LC), the gold standard of treatment of gallstone disease, is a widely performed surgery, but it can become a challenge to complete at times. Aim of present study was to find out the possible preoperative features in a gallstone disease patient that predispose him to having a difficult LC.
Methods: All cases of gallstone disease undergoing LC at a tertiary care hospital were studied over one year. Patients with jaundice, abnormal liver function tests, concomitant common bile duct stones, ongoing acute cholecystitis or concurrent gallstone pancreatitis were excluded. Various preoperative clinical, laboratory and ultrasound parameters were studied to see their correlation with different aspects of difficult LC.
Results: 166 patients were studied with age ranging from 10-80 years, maximum incidence (36.14%) being in the age group 35-50 years. The time taken for LC increased significantly with increasing age. 70.48% were females but gender status did not affect the difficulty. Pain in the preceding 15 days of surgery increased the operating time as did the association of diabetes mellitus. Increasing body mass index (BMI) also increased the surgery time as well as the conversion rate (7.69% in patients with BMI >30Kg/m^2). Clinically palpable gallbladder increased the surgery duration, difficulty and conversion rate. TLC >11000/mm^3, contracted gallbladder, wall thickness ≥4mm made LC longer, while multiple stones increased surgeon's difficulty and impacted stone in gallbladder neck increased the conversion rate.
Conclusions: Certain factors that increase the difficulty of LC can be identified preoperatively and this knowledge should be used when planning LC.

Keywords: Acute cholecystitis, Body mass index, Gallstones, Risk factors, Ultrasonography

INTRODUCTION

Gallstone disease is a major cause of global morbidity and mortality.[1] Prevalence rates based on ultrasound studies vary from 10%-15% in European adults to 3%-5% in African and Asian populations, while Indian figures have been reported as 3%-6%.[2,3] More than 80% of gallstone carriers are asymptomatic and it has been estimated that about 1%-2% of these develop complications and need surgery every year.[2] Complications of gallstone disease include acute and chronic cholecystitis, gallbladder perforation, choledocholithiasis with or without cholangitis, Mirizzi syndrome, cholecysto-enteric fistula, gallstone ileus and gallstone pancreatitis.

First described in 1882 by Langenbuch C, open cholecystectomy (OC) has been the primary treatment of gallstone disease for most of the past century.[4] This changed when, in 1987, Philippe Mouret from France introduced the first video-laparoscopic cholecystectomy and by 1993, the laparoscopic approach was adopted as the gold standard by the National Institutes of Health.[5,6]

Laparoscopic cholecystectomy (LC), though performed

extensively, requires favourable patient characteristics, suitable equipment support and adequate surgical expertise for successful completion. There will be a certain subset of patients where the laparoscopic approach may become time-taking, technically challenging and may even have to be abandoned, sometimes in an emergency, for the open approach. Rate of conversion from LC to OC has been variously described and ranges from 1% to 15% in literature and it is known that difficult cholecystectomies increase perioperative time and costs, complication rates, length of hospital stay and hospital costs.[7] Complications include bile duct injury, bile leak, significant bleeding, iatrogenic injuries to adjacent viscera and even death. It is, therefore, of paramount importance to identify the likely factors that predispose a patient to have a difficult LC. This will aid in identifying the subset of gallstone disease patients who require a special surgical planning.

Many authors have tried to identify such candidates either preoperatively based on some clinical, laboratory or ultrasound parameters; or early in the course of laparoscopic approach based on the per-operative findings.[7] This study was done to independently find out the possible preoperative (clinical, laboratory and ultrasound) factors in patients with gallstone disease that predispose them to have difficult LC based on the time taken, difficulty assessment by operating surgeon and conversion to OC.

METHODS

All cases of symptomatic gallstones undergoing elective LC at a tertiary care hospital were studied over one year in a prospective manner. Patients with jaundice, abnormal liver function tests, concomitant common bile duct stones, ongoing acute cholecystitis or concurrent gallstone pancreatitis were excluded.

The selected patients were counselled about the procedure and written informed consent was taken regarding participation in the study as well as for the surgical procedure. The patients were also informed of the likelihood of conversion to OC. The preoperative work up of the study population involved detailed history taking, clinical examination, laboratory investigations and ultrasound of abdomen.

Preoperative history taking protocol included age of the patient in years, gender, whether the patient had experienced biliary pain in the fifteen days preceding the surgery, past history of jaundice, acute cholecystitis, gallstone pancreatitis and associated diabetes mellitus. Preoperative clinical examination protocol included recording of body mass index (BMI), whether gallbladder was palpable per abdominally and if tenderness was present in the right hypochondrium.

Preoperative lab investigations were carried out as part of pre-anaesthesia check-up protocol and total leucocyte count (TLC) was considered for the study. Transabdominal ultrasound was done routinely in the preoperative work up to assess number and size of gallstones in gallbladder, if the gallstones were impacted in gallbladder lumen, if the gallbladder was contracted, the thickness of gallbladder wall and evidence of fatty or cirrhotic liver. It was repeated on the morning of the surgery, after overnight fasting to assess the immediate preoperative status, including the distensibility of gallbladder.

LC was done under general anaesthesia as per standard American technique, using a 10mm 0° telescope, three-chip video camera and high-resolution monitor. Pneumoperitoneum was created with carbon dioxide by using veress needle. Two trained laparoscopic surgeons, who had performed at least 100 LC earlier, were involved in the study. The surgeons opined on the per-operative degree of difficulty depending on an objective questionnaire which included presence and degree of peri-gallbladder adhesions and adhesions in the Calot's triangle, gallbladder wall thickness, estimated peroperative blood loss, requirement of abdominal drain, duration of the procedure, iatrogenic injury to neighbouring structures and if conversion to OC was required. The time taken for surgery from initial incision for insertion of veress needle to final skin closure was noted.

The various preoperative independent variables were correlated with the following dependent variables; time taken per-operatively, degree of difficulty encountered as per surgeon, and conversion to open surgery; and it was statistically analysed by Pearson correlation coefficient and Chi square test, p value was considered significant if <0.05.

RESULTS

The study included a total of 166 patients with age ranging from 10 years to 80 years. The maximum incidence (36.14%) was seen in the age group of 35 to 50 years (Figure 1). There was a higher proportion of females (70.48%). Six (3.61%) patients had experienced pain abdomen in last 15 days prior to the day of surgery.

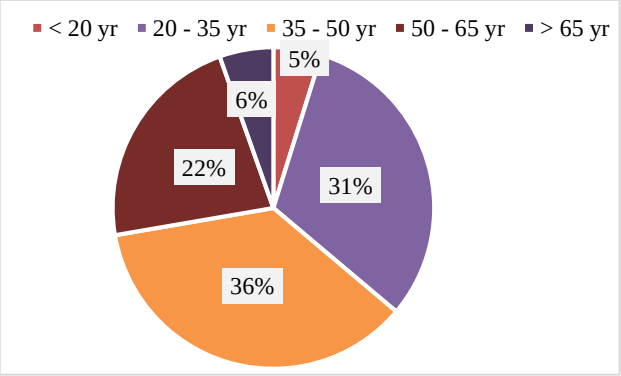

Figure 1: Age distribution of patients.

Table 1: Correlation of each independent variable with duration of surgery, per-operative difficulty and conversion to open surgery.

Variables	Duration of surgery (min)				Per-operative difficulty		Conversion to open	
	n	Mean	SD	SE of mean	Easy (n)	Difficult (n)	No (n)	Yes (n)
Age of patient (year)	p<0.05				p>0.05		p>0.05	
<20	8	54.38	6.78	2.40	8	0	8	0
20-35	52	54.42	12.07	1.67	48	4	52	0
35-50	60	55.25	8.99	1.16	57	3	59	1
50-65	37	59.86	19.60	3.22	32	5	35	2
65 and above	9	64.44	16.48	5.49	7	2	9	0
Total	166	56.48	13.45	1.04	152	14	163	3
Sex of patient	p>0.05				p>0.05		p>0.05	
Male	49	56.94	10.74	1.53	45	4	49	0
Female	117	56.28	14.48	1.34	107	10	114	3
Pain abdomen in last 15 days	p<0.05				p>0.05		p>0.05	
Yes	6	67.33	13.33	1.67	5	1	6	0
No	160	56.22	13.33	1.05	147	13	157	3
Associated Diabetes mellitus	p<0.05				p>0.05		p>0.05	
Yes	10	68.50	12.96	2.10	9	1	10	0
No	156	56.09	13.43	1.08	143	13	153	3
Past gallstone pancreatitis	p>0.05				p>0.05		p>0.05	
Yes	5	58.00	10.95	4.90	5	0	5	0
No	161	56.43	13.55	1.07	147	14	158	3
Past acute cholecystitis								
Yes	1	70	-	-	1	0	1	0
No	165	56.39	13.45	1.05	151	14	162	3
BMI (kg/m^2)	p<0.05				p>0.05		p<0.05	
<20	2	52.50	3.54	2.50	2	0	2	0
20.01 to 25.00	90	53.44	11.03	1.16	81	9	89	1
25.01 to 30.00	48	56.46	11.94	1.72	46	2	48	0
>30	26	64.38	21.72	4.26	23	3	24	2
Total	166	56.48	13.45	1.04	152	14	163	3
Palpable Gallbladder	p<0.05				p<0.05		p<0.05	
Yes	2	102.50	67.18	47.50	1	1	1	1
No	164	55.91	11.37	0.89	151	13	162	2
Tenderness right hypochondrium	p>0.05				p>0.05		p>0.05	
No	120	56.38	13.49	1.23	109	11	118	2
Yes	46	56.74	13.51	1.99	43	3	45	1
TLC/mm3	p<0.05				p>0.05		p>0.05	
≥11000	6	69.17	12.81	5.23	5	1	6	0
<11000	160	56.00	13.28	1.05	147	13	157	3
Multiple stones in gallbladder	p>0.05				p<0.05		p>0.05	
Yes	105	57.48	13.07	1.28	94	11	104	1
No	61	54.75	14.04	1.80	58	3	59	2
Impacted stone	p>0.05				p>0.05		p<0.05	
Yes	3	58.33	10.41	6.01	2	1	2	1
No	163	56.44	13.53	1.06	150	13	161	2
Contracted gallbladder	p<0.05				p>0.05		p>0.05	
Yes	3	66.33	23.09	3.33	2	1	3	0
No	163	56.35	13.30	1.04	150	13	160	3
Gallbladder wall thickness (mm)	p<0.05				p>0.05		p>0.05	
<4	156	56.12	13.23	1.06	145	11	153	3
≥4	10	66.00	16.36	5.17	7	3	10	0
Fatty liver	p>0.05				p>0.05		p>0.05	
Yes	5	62.00	17.89	8.00	4	1	5	0
No	161	56.30	13.33	1.05	148	13	158	3

Diabetes mellitus was present in 10 (6.02%) patients. Five (3.01%) patients gave history of gallstone pancreatitis in the past while only one (0.60%) patient had history suggestive of acute cholecystitis in the past.

In the study population, BMI ranged from 19.81kg/m^2 to 35.79kg/m^2. The maximum number of patients, viz. 90 (54.22%) had a BMI of 20.01-25kg/m^2. Gallbladder was palpable in two (1.20%) patients only while tenderness in right hypochondrium was demonstrated in 46 (27.71%) patients.

Six (3.61%) patients had TLC >11000/mm^3. 105 (63.25%) patients had multiple stones in gall bladder on preoperative ultrasound while three (1.81%) were found to have impacted stones in gallbladder neck or Hartmann's pouch. Ultrasound also revealed contracted gallbladder in three (1.81%) patients and gallbladder wall thickness ≥4mm in 10 (6.02%) patients. Five (3.01%) had sonographic evidence of fatty liver, but no cirrhotic livers were encountered.

Among the dependent variables, duration of surgery was >75 minutes in 8 (4.82%) patients, while overall mean duration of surgery was 56.48 minutes. In 14 (8.43%) patients, the surgery was described as difficult by the operating surgeon based on the objective parameters. In three patients, the laparoscopic surgery was not progressing satisfactorily and was converted to open approach, giving a conversion rate of 1.81%.

The correlation of these independent preoperative variables with duration of surgery, per-operative difficulty, and conversion to open surgery is summarised (Table 1).

DISCUSSION

LC is a well-accepted and well tolerated surgery for gallstone disease because of its established incidence of lower postoperative pain, lesser morbidity and shorter hospital stay. It is also an integral part of surgery residency program worldwide, with residents doing more LC than OC. Hence, LC is being done by surgeons of varying expertise, and a difficult LC can become disastrous in the hands of a laparoscopic surgeon who is at the start of his learning curve. The difficulty is usually caused by certain patient factors and if these can be identified preoperatively, it can benefit the patient by reducing the complications.

Age is one such factor which has been studied extensively. The present study found that as age of the patient increased, the time taken for surgery increased significantly in a linear fashion with maximum mean time of 64.44 minutes in the age group of 65 years and above. However, the author did not find any significant correlation with surgeon's difficulty or conversion to OC as was also reported by Jethwani et al in their study.[8] 16 out of 30 studies reviewed by Hu et al found that older age, more than 60 years or 65 years, was an important risk factor and patients >65 years had three to five-fold chance of conversion to OC.[7] Philip Rothman et al in their meta-analysis concluded that quality of evidence for age as a risk factor for conversion was low.[9] Kanakala et al found significantly higher cardiorespiratory complications and conversion to OC amongst older patients in univariate analysis, but age became non-significant when other factors were adjusted for in multivariate analysis.[10] Author feel elderly age should be kept as a risk factor when planning LC as it is associated with difficult Calot's triangle dissection due to recurrent attacks of inflammation in the past as well as due to association of co-morbidities.[11]

Male gender has often been considered to be associated with difficult LC, but the author found no significant difference between the genders when correlated with various dependent variables in present study. All the three conversions were in females. Hu et al found male gender to be a significant risk factor in 17 out of 30 studies reviewed by them, with studies by Lipman et al and Sanabria et al showing a four-fold higher risk in male.[7] Meta-analysis by Philip Rothman et al found that quality of evidence of male gender as a risk factor for conversion was low.[9] Vivek et al found that male sex was associated with difficult Calot's triangle dissection and increased gallbladder adhesions.[11] Kanakala et al found male sex to be the only significant factor to predict operative mortality in LC.[10]

An episode of biliary pain within 15 days prior to surgery was associated with significantly longer operating time in present study but it did not affect the reported per-operative difficulty or the rate of conversion. The possible explanation could be that the pain was associated with inflammation of gallbladder and may have caused adhesion formation or thickening of the gallbladder wall leading to lengthening of the surgery time. The other possible explanation is that these patients may be having frequent recurrences of pain leading to formation of more adhesions. This risk factor has not been reported in literature and, hence, may be worth evaluating further.

Concomitant diabetes mellitus was associated with longer duration of surgery but failed to show significant correlation with surgeon's difficulty or conversion rate. Stanisic et al reported significantly higher difficulty during LC in diabetics while Raman et al and Ibrahim et al too found diabetes mellitus to be an important risk factor.[12,7]

Author found significant correlation of rising BMI with increasing duration of surgery with the highest mean of 64.38 min in those with BMI >30kg/m^2 and lowest mean of 52.50 min in those with BMI <20kg/m^2. The rate of

conversion of 7.69% in their patients having BMI >30kg/m^2 was also significantly higher than in the remaining patients. 8 out of 19 studies reviewed by Hu et al concluded that high BMI is an important risk factor for conversion.[7] However, a meta-analysis by Philip Rothman et al found the quality of evidence for weight as a risk factor to be very low.[9] Vivek et al found that BMI >30kg/m^2 was associated with difficult umbilical port entry.[11] Stanisic et al found that BMI >30kg/m^2 significantly affected creation of pneumoperitoneum and placement of working ports.[12]

In the two patients of clinically palpable gallbladder in the present study, all the dependent variables of LC were significantly altered. The mean duration of surgery was significantly higher (102.5 minutes vs 55.91 minutes, p <0.05). So was the per-operative difficulty and conversion to open. However, no studies were found in literature that evaluated a clinically palpable gallbladder, instead there were studies which assessed either ultrasound or preoperative finding of distended gallbladder. Van der Velden et al found that a distended gall bladder ≥4.5cm was the only single ultrasound predictor of conversion.[13] Vivek et al reported that distended gallbladder significantly increased the difficulty in grasping of gallbladder, adhesiolysis, Calot's dissection and extraction of gallbladder.[11]

Author found a positive correlation between TLC >11000/mm^3 and duration of surgery, but it did not affect the surgeon's difficulty or the conversion rate. Hu et al reported significant association of TLC with conversion in 7 of the 20 studies they reviewed.[7] However, meta-analysis by Philip Rothman et al found the association to be of low quality.[9]

Among the stone characteristics, the author found multiple stones to increase surgeon's difficulty while impacted stone in gallbladder neck was associated with higher conversion rate. Vivek et al found multiple stones to be strongly associated with difficulty in adhesiolysis, Calot's dissection and gall bladder extraction.[11]

Stanisic et al found impacted stone in cystic duct or Hartmann pouch to significantly increase the difficulty in Calot's dissection.[12] As per review by Hu et al, association of impacted stone at gallbladder neck with conversion was of a high quality in a study by Goonawardena et al.[7]

The present study showed that the variables of contracted gallbladder and gallbladder wall thickness ≥4mm were strongly related to increased duration of surgery independently, but did not affect the surgeon's perceived difficulty or the conversion rate. Stanisic et al found gallbladder wall thickness >4mm to be significantly associated with difficult Calot's triangle and gallbladder dissection.[12] Vivek et al found contracted gallbladder to significantly affect dissection of gallbladder and Calot's triangle as well as extraction of the gall bladder.[11] Most studies in a review by Hu et al used wall thickness of >4 mm as a risk factor and found a strong association in 15 of the 20 studies, with risk of conversion going up to 6 times.[7] Philip Rothman et al, in their meta-analysis, found moderate quality of evidence to suggest that gallbladder wall thickness more than 4-5mm was a risk factor for conversion to OC.[9] They also found a similar correlation with contracted gall bladder on ultrasound.[9]

Author had only one case of interval LC for acute cholecystitis where the operation time was 70 minutes compared to the mean time of 56.39 minutes observed in the remaining cases and no conversion was required. Author has not drawn any inference from this as it was the only case, and this has been a limitation of the present study.

Stanisic et al have reported that previous attack of acute cholecystitis significantly increased the difficulty in dissection of gall bladder from the liver parenchyma.[12] Similar findings were also noted in a study by Nachnani et al.[14] Present study did not find any correlation of history of gallstone pancreatitis, tenderness in right hypochondrium or fatty liver with the dependent variables of LC. Both, review by Hu et al and meta-analysis by Philip Rothman et al, did not report any significance of these variables.[7,9] However, Nachnani et al had reported difficulty in delineating anatomy after previous attack of acute pancreatitis.[14]

As author had experienced surgeons operating on the study population, one of the dependent variables, i.e. conversion rate, was quite low (1.81%), whereas literature has reported up to 27.7%, the lowest being 1.8%.[9] Though the experience of the surgeons added strength to the present study, the low conversion figure would have skewed the data that has been generated and also its applicability, especially in a teaching hospital. Though the author tried to assess all possible predictors of difficult LC and different ways of interpreting a difficult LC, small numbers of palpable gallbladder, contracted gallbladder and impacted stone may have limited present study.

CONCLUSION

In conclusion, certain preoperative parameters like increasing age, rising BMI, pain abdomen in the preceding 15 days, concomitant diabetes mellitus, clinically palpable gallbladder, TLC >11000/mm^3, multiple gallstones, impacted stone in neck of gallbladder, contracted gallbladder and wall thickness ≥4mm are significant risk factors for difficult cholecystectomy and possible conversion to open surgery. Patients with these factors should be properly counselled regarding the higher chance of conversion and possible longer hospitalisation so that they can schedule their LC accordingly. These patients should be listed keeping in mind that surgery might be prolonged; and

they should be operated upon by an experienced surgeon or under his supervision to minimise complications.

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