

Research Article

Pre and per operative prediction of difficult laparoscopic cholecystectomy using clinical and ultrasonographic parameters

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ABSTRACT

Background: Cholecystectomy is the procedure of choice for symptomatic gall stones. Laparoscopic Cholecystectomy (LC) may be rendered difficult by various problems encountered during surgery. Several factors have been implicated with a difficult case, but no reliable criteria are available yet to identify patients preoperatively with a difficult LC. Preoperative prediction of a difficult LC can help the patient as well as the surgeon prepare better for the intraoperative risk and the risk of conversion to open cholecystectomy. The present study was undertaken to evaluate role of various factors responsible for conversion from laparoscopic to open cholecystectomy and also to study the intraoperative problems faced by the surgeon responsible for conversion in order to make the procedure safer for the patient as well as the surgeon.

Methods: In 50 consecutive patients who underwent LC during 2013 to 2014 patient's characteristics, clinical history, laboratory data, ultrasonography results and intraoperative details were prospectively analyzed to determine predictors of difficult LC.

Results: Of 50 patients 3 (06%) required conversion to open cholecystectomy. Significant predictors of conversion were obscured anatomy of Calot's due to adhesions, sessile gall bladder, male gender and gall bladder wall thickness >3 mm.

Conclusions: With preoperative clinical and ultrasonographic parameters, proper patient selection can be made to help predict difficult LC and a likelihood of conversion to open cholecystectomy.

Keywords: Difficult, Laparoscopic cholecystectomy, Ultrasonographic parameters, Open cholecystectomy

INTRODUCTION

The advent of laparoscopic era led to revolution in minimally invasive surgery for intra-abdominal pathology. No organ system has seen more progress in the treatment of disease than biliary tract. The first laparoscopic Cholecystectomy was performed by Muhe in 1985.¹ Laparoscopic Cholecystectomy (LC) may be rendered difficult by various problems encountered during surgery such as difficulties in accessing the peritoneal cavity & creating a pneumoperitoneum,

bleeding, dissection of gallbladder wall, stone & bile spillage and difficulty in extraction which may require conversion to open cholecystectomy.² These may be due to acute inflammation, aberrant anatomy, adhesions, unexpected operative abnormal findings, iatrogenic injuries, obesity and equipment failure.

We analyzed clinical and ultrasonographic parameters that may allow preoperative prediction of difficult LC which could help both the patient as well as the surgeon in order to remain better prepared for the intraoperative

catastrophes as well as the conversions to Open Cholecystectomy (OC). Prediction of a difficult LC would allow the patient to prepare psychologically as well as planning their recovery and explaining their absence from work. Another benefit would be to allow more efficient scheduling of the operative list and ensuring the availability of a more experienced laparoscopic surgeon for the procedure.³⁻⁵

METHODS

This prospective study was carried out on 50 patients who were admitted with symptomatic cholelithiasis in Surgery department at Maharishi Markandeshwar Institute of Medical Sciences and Research, Mullana (Ambala) to undergo LC. All eligible patients within a period from August 2013 to August 2014 were included in the study. The patients having concomitant common bile duct stones, suspected malignancy, patients below 16 years, those having features of acute cholecystitis/pancreatitis, similarly patients having comorbidities and patients not fit for general anaesthesia were excluded. Patients were admitted to the hospital one day prior to surgery and after a detailed clinical history and examination necessary investigations were performed. An informed consent was obtained. A single surgeon with experience of doing more than 250 LC over the last 5 years performed the LC.

Every patient was subjected to the following assessments which were regarded as risk factors for laparoscopic cholecystectomy.⁵

Preoperative (independent) variables included the following

Patients' characteristics

- 1) Gender.
- 2) Age was evaluated as both a continuous variable and a dichotomous variable (<65 years versus >65 years).
- 3) Weight, height and body mass index were used as continuous variables.
- 4) Body mass index (BMI) was calculated as:

$$\text{BMI (kg/m}^2\text{)} = \frac{\text{Weight in kilograms}}{\text{Squared height in meters}}$$

Patients that had BMI of 30 or more were considered obese according to the international definition.⁶

BMI was also used to describe body habitus as a dichotomous variable (obese >30 versus non obese <30).

Complaints, history and clinical examination

- 1) Symptoms of pain, dyspepsia and vomiting.
- 2) History of jaundice.
- 3) Acute cholecystitis was defined as right upper quadrant pain of acute onset, lasting more than 3

hours, in the presence of fever or leukocytosis, associated with cholelithiasis, thick gall bladder wall more than 4mm, evidence of peri-cholecystic fluid collection, and requiring emergency admission.

- 4) Previous abdominal surgery was categorized as no surgery versus any intra-abdominal surgery.
- 5) The clinical signs of cholecystitis: tender right hypochondrium, positive Murphy's sign and palpable gall bladder.

Laboratory data included: complete blood picture, bleeding and coagulation times, fasting blood sugar, serum urea and creatinine, liver transaminases, prothrombin time and activity, serum bilirubin and alkaline phosphatase.

Abdominal ultrasound included following parameters²

- 1) Shape of gall bladder: Gall bladder was defined as contracted or distended depending on the shape and transverse diameter. It was defined as distended if the transverse diameter was greater than 5 cm.
- 2) Gall bladder wall thickness was estimated by using the maximal obtainable measurement and evaluated as a dichotomous variable (thick ≥ 3 mm versus normal <3 mm).
- 3) The calculus size was evaluated as a dichotomous variable for the purpose of analysis (small <1 cm versus large ≥ 1 cm).
- 4) The number of calculi was classified as a dichotomous variable (solitary versus multiple).

The dependent variables (outcomes) included the following operative parameters

All cases underwent LC with assessment of the difficulties encountered in terms of:

- 1) Duration of surgery (in minutes): Duration of surgery included the time from insertion of Veress needle to closure of the trocar insertion site and was evaluated as a dichotomous variable (<45 min versus >45 min).
- 2) The subcostal angle was classified as narrow or wide; wide subcostal angle was defined as >90 degrees.
- 3) Bleeding during surgery: Bleeding during surgery was graded as minimal, moderate or severe. Moderate bleeding was defined as bleeding leading to tachycardia of greater than 100/minute without drop in blood pressure. Severe bleeding was defined as bleeding leading to tachycardia of greater than 100/minute with a greater than 10mm Hg drop in blood pressure.
- 4) Access to peritoneal cavity: The operating surgeon described the access to peritoneal cavity as "easy" or "difficult".
- 5) Gall bladder bed dissection: The operating surgeon described GB bed dissection as "easy" or "difficult" depending upon difficulty in grasping/retracting GB,

obscured anatomy of Calot's, adhesions, intrahepatic GB, anatomical variations.

- 6) Injury to (CBD/duodenum/small bowel/large bowel/omentum/liver), rupture of GB with spillage of stone/bile.
- 7) Difficult extraction: Extension of incision for extraction. The operating surgeon described GB extraction as "easy" or "difficult".
- 8) Conversion to open cholecystectomy (OC).

Statistical analysis

Univariate analysis was first performed using the chi-squared test to determine the factors that were associated with difficult LC, and odds ratios and their 95% confidence intervals were calculated and significance was demonstrated in every case ($p \leq 0.05$).

RESULTS

Out of 50 patients (32%) were in the age group of 40-49 years (range 8-77 years). The sex ratio Female: Male was 4:1. In our present study BMI was less than 30 in 68% and 32% had a BMI more than 30. Difficulty in access to peritoneal cavity was encountered significantly more often in male patients in comparison to females and in patients with advancing age (Table 1). Difficulty in access to peritoneal cavity was encountered significantly more often in obese patients ($p > 0.05$). There was no patient of acute cholecystitis. No patient had a history of upper abdominal surgery while 24% had a previous lower abdominal surgery. 22% patients had contracted GB while 72% had a distended GB. 18% patients had a GB thickness > 3 mm. 82% had multiple stones on USG.

Table 1: Relationship of difficulty in access to peritoneal cavity with various parameters (Age, sex & previous abdominal surgery).

	Access to peritoneal cavity		Total
	Difficult	Easy	
Age (years)			
<30	-	12	12
30-39	-	9	9
40-49	1	15	16
50-59	2	5	7
>60	1	5	6
Sex			
Male	2	8	10
Female	2	38	40
Previous abdominal surgery			
TAH	2	4	6
Inguinal hernia	1	-	1
B/L TL	-	3	3
Appendicectomy	-	2	2
No history	1	37	38
Total	4	46	50

Table 2: Gall bladder dissection in relation to various parameters (Age, sex & previous abdominal surgery).

	Gall bladder dissection		Total	X^2 , df, p value
	Difficult	Normal		
Age (years)				
<30	1	11	12	$X^2=15.8$; df=4; $p < 0.01$
30-39	5	4	9	
40-49	2	14	16	
50-59	3	4	7	
>60	5	1	6	
Sex				
Male	6	4	10	$X^2=4.5$; df=1; $p < 0.05$
Female	10	30	40	
Previous abdominal surgery				
TAH	3	3	6	
Inguinal hernia	1	-	1	
B/L TL	1	2	3	
Appendicectomy	-	2	2	
No history	11	27	38	
Total	16	34	50	

Table 3: Extraction of gall bladder in relation to various parameters (Age, sex & previous abdominal surgery).

	Extraction of Gall bladder		Total	X^2 , df, p value
	Difficult	Normal		
Age (years)				
<30	1	11	12	$X^2=15.8$; df=4; $p < 0.01$
30-39	5	4	9	
40-49	2	14	16	
50-59	3	4	7	
>60	5	1	6	
Sex				
Male	6	4	10	$X^2=4.5$; df=1; $p < 0.05$
Female	10	30	40	
Previous abdominal surgery				
TAH	3	3	6	
Inguinal hernia	1	-	1	
B/L TL	1	2	3	
Appendicectomy	-	2	2	
No history	11	27	38	
Total	16	34	50	

Moderate bleeding during surgery occurred in 6 patients and none had severe bleeding out of which one required conversion. Bleeding occurred more often from GB bed followed by omentum and port site. Dissection of GB bed was more often difficult in patients with increase in age 83.33% were in age group more than 60 years whereas in 60% of males dissection was found to be difficult in comparison to females (25%) (Table 2). It was also

observed that past history of abdominal surgery dissection became difficult, in our study lower abdominal surgeries like hysterectomy (40%). Difficulty in extraction was there in 8 patients associated with large size stone impacted with thickened gall bladder for which port site was enlarged (Table 3). In 30% of patients laparoscopic cholecystectomy was difficult. In 8% patient's access to the peritoneal cavity was difficult and male gender was seen associated with difficult access.

Three patients (6%) required conversion from LC to OC, because of the following reasons: dense adhesions with obscured Calot's anatomy, moderate bleeding, and sessile GB. On univariate analysis, five factors were significantly associated with conversion to OC; these included: obesity, patient gender, past history of acute cholecystitis or acute pancreatitis, past history of upper abdominal surgery, and GB wall thickness >3 mm. A higher value of *p* indicates a higher likelihood of conversion, with a value of 1.0 indicating certainty of conversion to OC.

DISCUSSION

In this study we aimed to determine per operative risk factors that can be used to predict a "difficult cholecystectomy" and the risk of per-operative complication to optimize peri-operative management. Such prediction may allow a surgeon to be better prepared, to take extra precautions to reduce intra-operative complications, and to convert from LC to OC at an earlier stage. Conversion to OC is required in 2% to 15% of patients undergoing LC.^{7,8} The need for conversion to laparotomy is neither a failure nor a complication, but an attempt to avoid complications and ensure patient safety.⁹ The risk of conversion to OC is related to surgeon factors, patient factors and, possibly, equipment factors. The most common reason for conversion in our study was inability to delineate the anatomy due to dense adhesions. Three factors, namely, past history of upper abdominal surgery, past history of acute cholecystitis or acute pancreatitis, and greater thickness of the GB wall, were associated with difficulty in defining the anatomy.

Previous abdominal surgery poses problems during creation of pneumoperitoneum and during adhesiolysis to gain adequate exposure to the operative field; these problems depend in a large measure on the location of previous surgery. History of acute cholecystitis or acute pancreatitis results in a scarred and fibrosed GB, and in dense fibrotic adhesions leading to a difficulty in delineation of the anatomy.^{10,11} The other two factors that significantly predicted the risk of conversion included BMI >30 kg/m² and male gender. Obesity is known to make access to the peritoneal cavity difficult, thus necessitating conversion to open laparotomy.^{12,13}

In this study 68% had BMI ≤ 30, and 32% patients were having BMI > 30, but there was no significant difference

in obese patients with regard to conversion rates and operative time (*p* > 0.05). The reason for higher conversion rates in male patients remains unexplained, though male gender has been a significant risk factor in most series.^{8,14} It has been observed that male patients have more intense inflammation or fibrosis, resulting in more difficult dissection both in the triangle of Calot's and through the plane between the GB and the liver. In our study we encountered difficulty in access in four patients. Although the other two factors were moderate bleeding and sessile gall bladder. Out of six patients who suffered moderate bleeding during surgery in the present study one with uncontrolled bleeding required conversion. Kama et al. (2001) reported 4 patients out of 1000 in which conversion was required due to uncontrolled hemorrhage.¹⁵ Clinically significant bleeding occurs in 0.5% of LC.¹⁶

Ultrasonographic findings of thick GB wall (>3.5 mm) incurred a six fold increase in the conversion rates. In the present study thick GB was associated with difficult dissection, rupture of GB, increased incidence of bleeding, increased duration of surgery and increased rate of conversion. Contracted GB with WES sign on ultrasound was associated with difficult dissection and also cause increased chances of conversion. Sharma et al. (2007) studied 200 patients undergoing LC also found cases with contracted GB on ultrasound had unclear Calot's and 3/42 patients required conversion.¹⁷ At the same time distended GB on ultrasound 4/32 patients needed conversion because of unclear Calot's anatomy.

In our study difficulty in GB extraction was associated with size of GB stone >15 mm, impacted stone in Hartmann's pouch and extension of incision was required in 8 (16%) patients. Nachnani & Supe (2005) also concluded that difficulty in extraction was associated with a calculus of size more than 1 cm but not with number of stones.² In Gabriel et al. (2009) study, a higher rate of conversion (34%) was seen in patients with multiple calculi. Sixty patients had GB wall thickness more than 3 mm, out of which 60% (n=41) had conversion.¹⁸

In a prospective study of 1676 patients, Fried et al. found that age, gender, acute cholecystitis, obesity, and thickened GB wall were significant predictors for conversion from LC to OC.⁴ Patients with a high predicted risk of conversion could be operated on either by or under the supervision of a more experienced surgeon.⁸ Also, a high predicted risk of conversion may allow the surgeon to take an early decision to convert to OC when difficulty is encountered during dissection; this may shorten the duration of surgery and decrease the associated morbidity.¹⁵

CONCLUSION

So, the clinical and ultrasonographic findings may help predict a difficult LC. This information may be useful to

both the patient and the treating surgeon. The preoperative parameters that significantly predicted difficult LC were based on the clinical criterion of presence of local signs of cholecystitis in addition to ultrasonographic criteria of not only large stones but thick and fibrosed GB due to previous attacks of acute cholecystitis. However patients age, body habitus, previous lower abdominal surgery, past history of jaundice, shape of GB and number of stones had no significant effect on the course of surgery.

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REFERENCES

- Mühe C. Cholecystektomie durch das Laparoskop. *Langenbecks Arch Klein Chir.* 1986;369:804.
- Nachnani J, Supe A. Preoperative prediction of difficult laparoscopic cholecystectomy using clinical and ultrasonographic parameters. *Indian J Gastroenterol.* 2005;24(1):16-8.
- Sanabria JR, Gallinger S, Croxford R, Strasberg SM. Risk factors in elective laparoscopic cholecystectomy for conversion to open cholecystectomy. *J Am Coll Surg.* 1994;179:696-704.
- Fried GM, Barkun JS, Sigman HH, Lawrence J, Clas D, Garzan J, et al. Factors determining conversion to laparotomy in patients undergoing laparoscopic cholecystectomy. *Am J Surg.* 1994;167:35-41.
- Abdel Baki NA, Motawei MA, Soliman KE, Farouk AM. Pre-operative prediction of difficult laparoscopic cholecystectomy using clinical and ultrasonographic parameters. *JMRI.* 2006;27(3):102-7.
- Angrisanil L, Lorenzo M, De Palma G. Laparoscopic cholecystectomy in obese patients compared with non-obese patients. *Surg Laparosc Endosc.* 1995;5:197-9.
- Alponat A, Kum CK, Koh BC, Rajnakova A, Goh PM. Predictive factors for conversion of laparoscopic cholecystectomy. *World J Surg.* 1997;21:629-33.
- Sanabria JR, Gallinger S, Croxford R, Strasberg SM. Risk factors in elective laparoscopic cholecystectomy for conversion to open cholecystectomy. *J Am Coll Surg.* 1994;179:696-704.
- Kologan M, Tutuncu T, Yuksek YN, Gozalan U, Daglar G, Kama NA. Using a risk score for conversion from laparoscopic to open cholecystectomy in resident training. *Surgery.* 2004;135:282-7.
- Daradkeh SS, Suwan Z, Abu-Khalaf M. Preoperative ultrasonography and prediction of technical difficulties during laparoscopic cholecystectomy. *World J Surg.* 1998;22:75-7.
- Santambrogio R, Montorsi M, Bianci P, Opocher E, Schubert L, Verga M, et al. Technical difficulties and complications during laparoscopic cholecystectomy: predictive use of preoperative ultrasonography. *World J Surg.* 1996;20:978-82.
- Phillips H, Carroll BJ, Fallas MJ, Pearlstein AR. Comparison of laparoscopic cholecystectomy in obese and non-obese patients. *Am Surg.* 1994;60:316-21.
- Schirmer BD, Dix J, Edge SB. Laparoscopic cholecystectomy in the obese patient. *Ann Surg.* 1992;216:146-52.
- Sikora SS, Kumar A, Saxena R, Kapoor VK, Kaushik SP. Laparoscopic cholecystectomy: can conversion be predicted? *World J Surg.* 1995;19:858-60.
- Kama NA, Kogoglu M, Doganay M, Reis E, Atli M, Dolapci M. A risk scores for conversion from laparoscopic to open cholecystectomy. *Am J Surg.* 2001;181:520-5.
- Dezeil DJ, Millikan KW, Econmou SG, Doolas A, Ko ST, Airan MC. Complications of laparoscopic cholecystectomy - A national survey of 4292 hospitals and an analysis of 77604 cases. *Am J Surg.* 1993;165:9-14.
- Sharma SK, Thapa PB, Pandey A, Kayastha B, Poudyal S, Uprety KR, et al. Predicting difficulties during laparoscopic cholecystectomy by preoperative ultrasound. *Kathmandu Univ Med J.* 2007;5(1):8-11.
- Gabriel R, Kumar S, Shrestha A. Evaluation of predictive factors for conversion of laparoscopic cholecystectomy. *Kathmandu Univ Med J.* 2009;7(1):25-30.

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