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Original Research Article

Preoperative Gallbladder Scoring for Predicting the Conversion of Laparoscopic Cholecystectomy to Open Cholecystectomy and Associated Risk Factors

Shobha Pakhriya[1], Deepak Kumar Soni[2]*, Yogendra Pratap Maurya[3], Niharika[4]

[1]Assistant Professor, Department of General Surgery, Hind Institute of Medical Sciences, Safedabad, Barabanki, U.P.
[2]Assistant Professor, Department of General Surgery, Hind Institute of Medical Sciences, Safedabad, Barabanki, U.P.
[3]Assistant Professor, Department of Anesthesiology, Prasad Institute of Medical Sciences (PIMS) & Hospital, Sarai Shahzadi Banthara, Junab Ganj, Lucknow, U.P.
[4]Associate Professor, Department of General Surgery, Hind Institute of Medical Sciences, Safedabad, Barabanki, U.P.

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Corresponding Author: Dr. Deepak Kumar Soni
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Abstract:

Introduction: Laparoscopic cholecystectomy is a gold-standard approach for cholecystectomy, has surprisingly variable outcomes and conversion rates. Operative grading has recently been reported to define disease severity and few have also been validated. The aim of this study was to assess an operative scoring system to assess its ability to predict the need for conversion from laparoscopic to open cholecystectomy and evaluated the associated risk factors.

Methods: A total of 105 patients of sexes (male-66, female-39), aged 18-80 years and socio-economic status were included in this study. All routine investigations and USG (Ultrasonography) were done. Risk factors assessed were age, sex, abdominal tenderness, gall bladder wall thickness, any history of para-umbilical surgery. Clinical evaluation was also done for each included patient and two scoring systems (World Society of Emergency Surgery -WSES-WG-10 [4] & Randhawa- GR-15 [2] were employed according to their signs and symptoms. Patients were categorised subsequently into easy (group 1), difficult (group 2) and severe (group 3) difficulty as per scoring method.

Results: The mean age of the patients was 51.02 ± 11.26 years (range, 18–80),(95 % CI 47.56 to 49.86) with 39 females and 66 males; females were aged 49.45 ± 12.81 years (range, 21–73), whereas males were aged 52.60 ± 13.12 years (range, 23–79). Among the converted group, 6 (5.71%) participants were ≥ 60 years of age and 3 (2.85 %) participants were of age ≤ 60 years. According to patient's expected level of difficulty in laparoscopic cholecystectomy and according to scoring system, patients were categorised as easy, difficult and severe. A total of 56 (53.33%) patients were categorised as easy, 40 (38.09%) as difficult and 9 (8.57%) as severe. Conversion rate was 0 % in easy group, 1/2.5 % in difficult group and 9/100 % in severe group. In this study, the conversion rate from laparoscopic to open cholecystectomy was 8.57%. It was also found that at a preoperative cut-off mean score of ≥ 6. 84, the sensitivity and specificity for predicting easy cases were 88.2% and 73.8%, respectively, and had an accuracy of 88.6% for easy cases and 68.5% for difficult cases. RG-15 could be used with some factors as GB wall thickness ≥ 4mm, age≥ 60 years, BMI≥ 27.5, Leucocyte count ≥ 10.000µl for future.

Conclusion: This intraoperative scoring system was effective and accurate. Additionally, it signified the need for conversion from laparoscopic to open cholecystectomy in cases of severe cholecystitis.

Keywords: Operative grading score, laparoscopic cholecystectomy, conversion rate.

Introduction

Cholelithiasis is a serious problem in modern medicine. Gallbladder operations for cholelithiasis are the most common procedures performed in general surgery. Currently the majority of cholecystectomies are performed laparoscopically. Recent epidemiological studies indicate that there has been an increase in the incidence of gallstone disease in patients with coronary insufficiency and liver diseases [1,2]. Laparoscopic cholecystectomy (LC) is a standard treatment for gallstone disease

[3]. LC results in a lower overall complication rate and shorter postoperative hospital stay compared to open cholecystectomy (OC) [4]. Laparoscopic cholecystectomy (LC) has become the procedure of choice for management of symptomatic gall stone disease. 1 Approximately, 2– 15% of attempted LC have to be converted to an open procedure due to various difficulties faced while performing the procedure. 2 Various clinical and ultrasonological parameters that may help to predict the difficulty level preoperatively were analyzed in the present study. Such prediction done preoperatively may help the patient as well as the surgeon in being better prepared for the intra-operative challenges. With the help of accurate prediction, high risk patient may be counselled before the surgery regarding the probability of conversion. On the other hand, surgeons could be prepared for the possible complications that might arise and take necessary precautions in these high risk patients [5].

In situations where LC is dangerous, a surgeon may be forced to change from laparoscopy to the open procedure. Literature data shows that 2 to 15% of laparoscopic cholecystectomies are converted to open surgery during surgery for various reasons [6,7]. The surgeons related predisposing factors have been proposed the surgeon's experience and the development of serious intraoperative complications.

Patient Related Factors:

Age and Gender: Many studies had disclosed that the male gender and aged above 65 years old were the two most recognizable predisposing factors for conversion. It was proposed that inflammation and fibrosis were more extensive in men than in women causing difficult dissection at Calot's triangle during LC, fact predisposing to conversion [8] .

Obesity: Patients with an increased body weight have been reported to be especially prone to more severe inflammation or fibrosis of the gallbladder, making the dissection more difficult, while technical difficulties related to the trocars placement, the obscure anatomy because of the excessive intraperitoneal fat presence and the inability to retract the liver sufficiently, make obese patients prone to conversion [9].

Diabetes Mellitus: Poorly controlled diabetes caused autonomic and peripheral neuropathy; thus diabetic patients may not develop symptoms of gallstones until later in the course of the disease, fact which may lead to a delayed diagnosis and more severe inflammation, increasing the risk for conversion during the laparoscopic procedure. Whether diabetes represents a predisposing factor for conversion remains controversial [10].

Cirrhosis: Cirrhosis and compromised multiple organ function usually co-exist, while the hardness of the fibrotic liver and its increased vasculature secondary to portal hypertension with a high risk for bleeding, constitute major intraoperative difficulties, LC was considered as a contraindication in cirrhotic patients [11].

Comorbid Cardiopulmonary Disease: It was well established that patients with American Society of Anaesthesiology (ASA) score 3,4 and 5, compared to them with ASA score 1 and 2 as well as patients with comorbidities compared to low anesthetic risk ones , were at an increased—nearly double risk for conversion. Moreover, the positive pressure of pneumoperitoneum has adverse effect on the stroke volume and the cardiac index in patients with significant ischemic heart disease. The abdominal wall lift and the low pressure pneumoperitoneum techniques have been used to overpass the problem [12].

Comorbidities: A nationwide study had disclosed a higher incidence of conversion rate among patients with malignancy as well as among psychiatric ones. Immunosuppression caused by the tumor itself or its therapy and conceal of the symptoms caused by the mental disorders themselves or the drugs used to treat them, delay the diagnosis, leading to more advanced stage of the disease at the time of diagnosis, causing more intraoperative technical difficulties, finally increasing the probability for conversion [13].

Disease related factors:

Biliary colic: It was proposed that the breakpoint of more than 10 biliary colic attacks was a highly significant predictor for conversion [14]

Gallbladder's wall abnormalities: The terms "thickened gallbladder's wall" and "pericholecystic fluid" are the imaging findings unspecifically used in the literature to describe preoperatively terms such as acute cholecystitis, "complicated" cholecystitis and "difficult" gallbladder. Since the proposed sonographic signs (e.g., wall thickness, wall striations, pericholecystic free fluid, local inflammatory fat changes) are neither sensitive nor specific enough to definitively diagnose acute cholecystitis, the accurate diagnosis of a thickened gallbladder's wall should be based on the CT findings [15].

The "difficult" gallbladder: The term "difficult" gallbladder is mainly based on intraoperative findings and is strongly depended on surgeons' skills to handle with a thickened gallbladder's wall (difficulties to grasp and retract the gallbladder, limitations in anatomic definitions, and failures in dissection), adhesions, concomitant choledocholithiasis or Mirizzi's syndrome. Thus, meta-analyses and clinical studies encountering the

objective intraoperative findings of a "difficult gallbladder" or a "thickened gallbladder's wall" as possible parameters affecting conversion, logically concluded that a gallbladder's wall of more than 5 , 6 or 7 mm predicts difficulty with anatomic exposure, predisposing to conversion [16,17].

Acute cholecystitis: Acute cholecystitis is a severe inflammation accompanied by increased vascularity and dense adhesions that interfere with good visualization, whereas the thick-walled gallbladder is often shrunken and contracted. Therefore, the cystic duct becomes shortened and the gallbladder adherents to the CBD, making its grasp for retraction difficult and its dissection from the CBD unsafe. Reports from national registries, disclosed that whenever any of the above happened, the conversion rate was increased by 3-fold, compared to the simple acute cholecystitis cases [18]

Mirizzi syndrome: Mirizzi syndrome is encountered in 0.3–3% of all LC, For accurate diagnosis of the disease a high index of suspicion is required, and it should be suspected in any case of empyema, mucocele or stone impaction in the infundibulum, Mirizzi syndrome was considered as a contraindication for laparoscopic approach, since it was carrying a conversion rate of up to 74% for Type I and up to 100% for Type II [19].

Gallbladder cancer: Gallbladder cancer is mainly an incidental diagnosis. In the vast majority of the patients is diagnosed postoperative on the histological examination and exceptionally rare constitutes an intraoperative finding during LC. The incidence of the disease has been reported as low as 0.05% in simple LC, increasing to 0.60% in converted LC [20].

Biliary Pancreatitis: A study recently addressed that in cases of mild acute biliary pancreatitis, LC should be offered as definitive treatment during the same admission of the patient and ideally within 7 days from the onset of symptoms. Thus, mild acute biliary pancreatitis should not be considered as a predisposing factor for conversion [21].

Concomitant CBD stone(s): It was reported that, 14.7% of the patients with gallstones have concomitant choledocholithiasis, while its incidence has been reported as high as 43% in patients older than 80 years. However, the role of choledocholithiasis as a predisposing factor for conversion is debatable and contradictionary results have also been published [22].

Laboratory parameters:

C reactive protein (CRP): Elevated CRP plasma levels reflect the severity of an inflammation and are used for the estimation of the inflammation process in acute cholecystitis cases. A study disclosed that plasma CRP level >200 mg/dL has 100% sensitivity, 87.9% specificity and 100% negative predictive value for gangrenous cholecystitis, proposing CRP >200 mg/dL as an indicator for early/urgent operation [23].

White blood cell count (WBC): WBC represents one of the most exhaustively investigated factors which might affect the conversion rate. A study chosen cut-off level as 9×103 cells/mm3 , while others set the cut-off level in 10×103 , 11×103 , or 12×103 [10, 30] . Other studies disclosed elevated WBC as an independent predisposing for conversion factor [6, 24],

Liver function tests (LFTs): Total bilirubin, alkaline phosphatase (ALP) and γ-glutamyltransferase (γGT) have been studied as factors predisposing to conversion. While other found that an increased bilirubin can increase the risk for conversion up to three-fold. For alkaline phosphatase, the majority of the studies did not find any association [3,23,] while others, disclosed ALP as a predisposing factor for conversion. Finally, γGT has been disclosed as a strong predisposing factor for conversion [25].

Serum albumin: Severe inflammation, as in cases of acute cholecystitis, results in decreased albumin synthesis, while hypoalbuminemia can also be the result of protein-calorie malnutrition or reduced hepatic synthetic secondary to cirrhosis or other hepatic diseases. Since, low serum albumin level has been shown to predict postoperative complications in general, hypoalbuminemia has been studied as a risk factor for conversion and several reports disclosed it as a strong and independent variance for conversion [26, 27].

Surgeon's related factors: Surgeon's experience Studies from Western countries clearly stated that in general, the conversions rates are lower among the well-trained high-volume laparoscopic surgeons, compared either to the general surgeons or to the inexperienced laparoscopic ones.

On the other hand, the finding of increased conversion rates among the more experienced surgeons, probably reflects the fact that more likely an experienced surgeon will be involved in a difficult LC in high risk surgical patients [28,29]

Serious intraoperative complications: The most common intraoperative complication leading to conversion is the intraoperative bleeding, followed by the suspicion for bile duct injury [30]. Complications such as duodenal injury, life-threatening intraabdominal bleeding from puncture of the inferior vena cava or the external iliac artery by a trocar, injury to the right portal vein branches, uncontrollable bleeding from the liver bed and small bowel injury caused by the blind insertion of the umbilical trocar, have been described as factors

which can enforce a surgeon to convert the LC [31].

The aim of this study was to assess an operative scoring system to assess its ability to predict the need for conversion from laparoscopic to open cholecystectomy and evaluated the associated risk factors.

Materials and Methods:

Materials: The study was conducted in the Department of General Surgery, Hind Institute of Medical Sciences, Safedabad, Barabanki, UP, India. This study was commenced after obtaining approval from the ethical committee of the institution. A total of 105 patients of both sexes were included in the study. Two preoperative scoring systems [I) WSES-G10 & ii) Randhawa-GR-15] [2,4] were used and subsequently was given to every patient on the basis of history, clinical examination and sonological findings (Table-1 & 2).

Maximum score was given as 10 & 15 respectively. Scores up to ≤3 & ≤ 5 respectively were defined as easy and scores of ≥4 & ≥6 were defined as difficult subsequently ≥5 & ≥8 were defined as very difficult respectively. Cases defined to be difficult were predicted to be converted to open surgery and those defined to be easy were predicted to be performed laparoscopically. All the surgeries were performed by the consultants of the institution with equal experience in the field of laparoscopic surgery. Surgery was done using CO2 pneumoperitoneum and using standard two 5 mm and two 10 mm ports. Time was noted from first port site insertion till the last port closure.

Table 1: Cholecystitis severity score used for WSES- WG10 [4]

Cholecystitis severity	**Score**
Appearance	
Adhesions < 50% of GB	1
Adhesions> 50% but GB buried	2
Completely buried GB	3 (max)
Distension/contraction	
Distended GB or contracted shrilled GB	1
Inability to grasp without decompression	1
Stone > 1 cm impacted in Hartmann's pouch	1
Access	Access
BMI > 30	1
Adhesions from previous surgery limiting surgery	1
Sepsis and complications	
Free bile or pus outside the gallbladder	1
Fistula	1
Total possible	10

Table 2: Preoperative scoring parameters used for grading the patient (GR15).Randhawa [2]

Variables/ Levels		**Score**	**Maximum Score**
Age Years	≤50	0	1
	≥50	1	
Gender	Male	1	1
	Female	0	
History of Hospitalization for acute cholecystitis	Yes	3	3
	No	0	
BMI kg/m^2	≤25	0	3
	25-27.5	2	
	≥27.5	3	
Abdominal Scar	NO	0	2
	Infraumbilical	1	
	Supraumbilical	2	
Palpable Gallbladder	Yes	1	1
	No	0	
USG: Wall thickness	≤4mm -Thin	0	2
	≥4mm- Thick	2	
Leucocyte count	≤10.000 µl	0	2
	≥10.000µl	2	

Score 0–5 = easy; score 6–8 = difficult; score 8–15 = very difficult. BMI, body mass index; ERCP, endoscopic retrograde cholangiopancreatography

Table 5: Operative Difficulty Grading [≥5 - 8]:

Grade	Parameters
Easy	Time Taken≤60 minutes
	No Bile Spillage
	No injury to duct, artery
Difficult	Time Taken 60-120 minutes
	Bile/ Stone Spillage
	Injury to bile duct
Very difficult	Time Taken ≥120 minutes
	Conversion

Statistical analysis: Statistical analysis was performed using the Statistical Package for the Social Sciences, version 11.0 (SPSS, Chicago, IL, USA). Categorical variables were expressed as frequencies (and percentage), and continuous variables were expressed as the mean ± standard deviation.

The chi-square test was used to evaluate potential associations between categorical variables, whereas odds ratios (ORs) and 95% confidence intervals (CIs) were calculated using simple logistic regression analysis. A multivariate stepwise logistic regression model was constructed to explore the independent effect of variables that showed a significant influence on conversion by univariate analysis. The patients gender, age, severity of inflammation, diabetes, and history of previous upper or lower abdominal surgery were included as independent variables. All tests were two tailed, and statistical significance was defined as $p \leq 0.05$

Results

A total of 105 patients, aged 18-80 years,[95 % CI 47.56 to 49.86] underwent LC between May 2022 and January 2024 [39 females (37.14%) and 66 males (62.85%)]. The mean age of the patients was 51.02 ± 11.26 years (range, 18–80); females were aged 49.45 ± 12.81 years (range, 21–73), whereas males were aged 52.60 ± 13.12 years (range, 23–79). Table-3, summarized the preoperative characteristic of patients.

Table 3: Preoperative characteristics of the study patients

Patients Characteristics		No. of Patients (%), n=105
Age Years	≤50	71 (67.61%)
	≥50	34 (32.38%)
Gender	Male	66 (62.85%)
	Female	39 (37.14%)
History of Hospitalization for acute cholecystitis	Yes	24 (22.85%)
	No	81 (77.14%)
BMI kg/m^2	≤25	58 (55.23%)
	25-27.5	42 (40%)
	≥27.5	5 (4.67%)
Abdominal Scar	No	98 (93.33%)
	Infraumbilical	7 (6.66%)
	Supraumbilical	0 (0%)
Palpable Gallbladder	Yes	82 (78.09%)
	No	23 (21.90%)
USG: Wall thickness	≤4mm -Thin	58 (55.23%)
	≥4mm- Thick	47 (44.76%)
Leucocyte count	≤10.000 µl	23 (21.90%)
	≥10.000µl	82 (78.09%)

Table 4: Relationship of risk factors with preoperative score

Patients Characteristics		Preoperative Score, n=105			P value, r
		Easy, n (%)	Difficult, n (%)	Very Difficult, n (%)	
Age Years	≤50	47 (44.76%)	21 (20%)	3 (2.85%)	0.05, 0.163
	≥50	9 (8.57%)	19 (18.09%)	6 (5.71%)	
Gender	Male	37 (35.23%)	24 (22.85%)	5 (4.67%)	0.05, 0.164
	Female	21 (20%)	14 (13.33%)	4 (3.80%)	
History of Hospitalization for acute cholecystitis	Yes	6 (5.71%)	17 (16.19%)	1 (0.95%)	0.05, 0.213
	No	45 (%)	28 (26.66%)	8 (7.61%)	
BMI kg/m^2	≤25	32 (30.47%)	26 (24.76%)	0 (0%)	0.05, 0.232
	25-27.5	29 (27.61%)	8 (7.61%)	5 (4.67%)	
	≥27.5	0 (0%)	1 (0.95%)	4 (3.80%)	
Abdominal Scar	No	65 (61.90%)	37 (35.23%)	3 (2.85%)	0.05
	Yes	0 (0%)	1 (0.95%)	6 (5.71%)	
Palpable Gallbladder	Yes	48 (45.71%)	26 (24.76%)	8 (7.61%)	0.05
	No	12 (11.42%)	10 (9.52%)	1 (0.95%)	
USG: Wall thickness	≤4mm - Thin	35 (33.33%)	22 (20.95%)	1 (0.95%)	0.32
	≥4mm-Thick	8(7.61%)	31 (29.52%)	8 (7.61%)	
Leucocyte count	≤10.000 µl	13 (12.38%)	8 (7.61%)	2 (1.90%)	0.05
	≥10.000µl	12 (11.42%)	63 (60%)	7 (6.66%)	

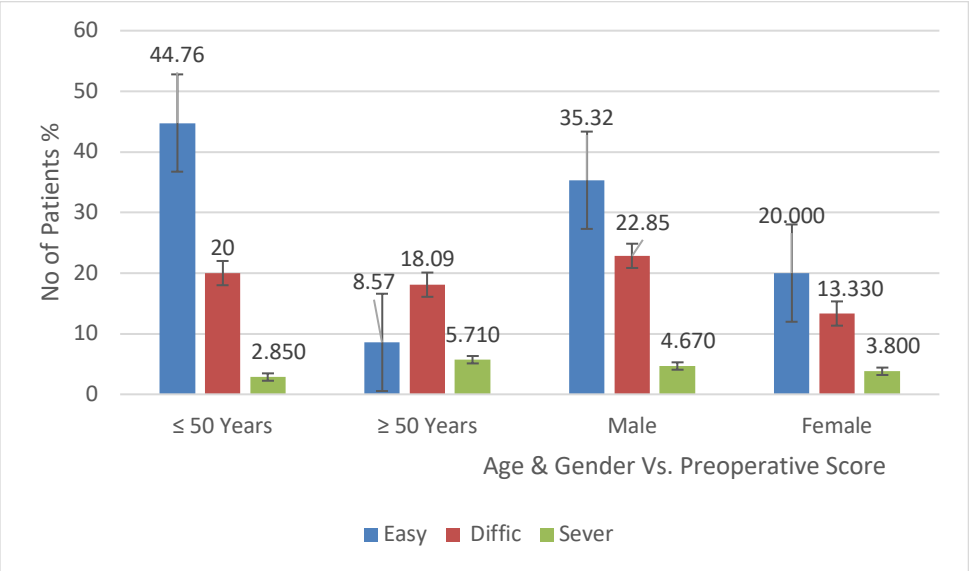

Figure 1: Age and gender related comparative preoperative score

Figure-1 revealed that, males are more prone as compared to females with their advancing age towards difficulty for conversion. It was also found significant (p=0.05) It was also found that 25/ 23.80% of patients were ≥ 50 years of age, under degree of difficulty whereas 24/ 22.85% of patients were ≤ 50 years of age, under degree of difficulty.

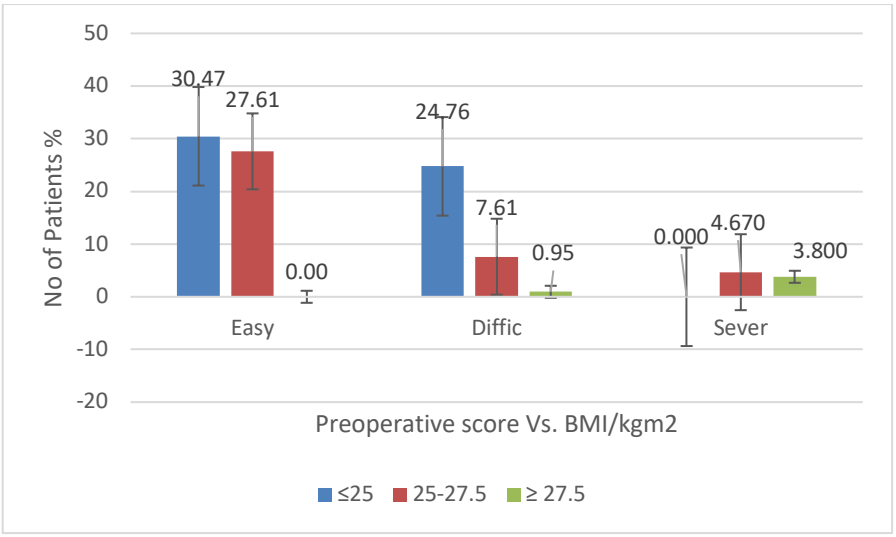

Figure 2: BMI related comparative preoperative score

Figure-2, advocated that the conversion rate directly proportionate to BMI.

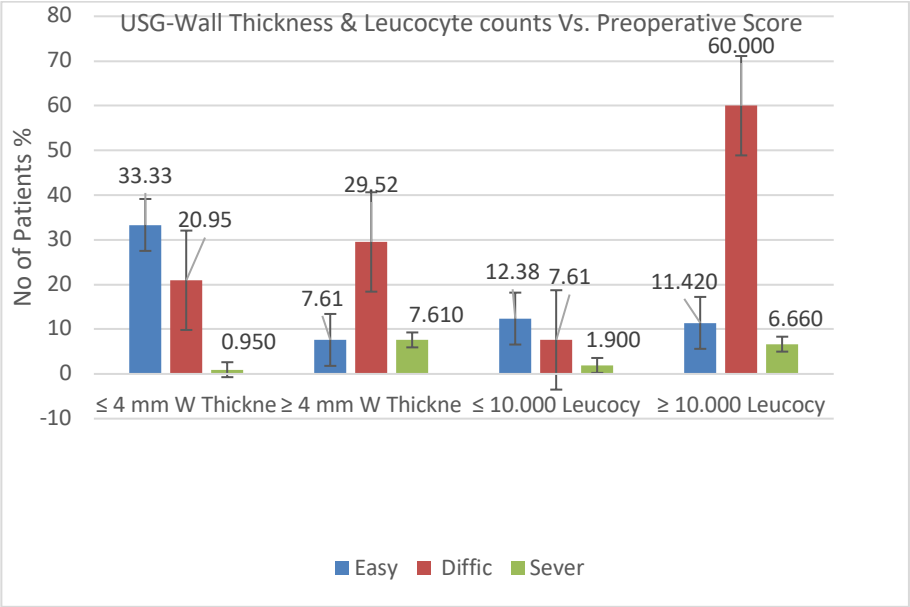

Figure 3: USG- Wall Thickness & Leucocyte Counts related comparative preoperative score

Figure-3 revealed that gallbladder wall thickness & leucocyte counts are directly proportionate to conversion. The mean thickness of the GB wall was 3.9±1.6 mm, so a GB wall thickness of ≤ 4 mm or was seen in 58 (55.23%) patients whereas ≥ 4mm was found in 47 (44.76%) patients during sonography.

Table 5: Summary table of relationship analysis on intraoperative outcome with preoperative score category with chi-square.

Preoperative Score	Easy (0-3)	Difficult (3.5-7.5)	Very Difficult 7.5-15	Total, n (%)	r, P Value
Easy	50 (47.61%)	6 (5.71%)	0 (0%)	56 (53.33%)	0.05, 0.169
Difficult	6 (5.71%)	33 (31.42%)	1 (0.95%)	40 (38.09%)	0.05,0.211
Very Difficult	0 (0%)	1 (0.95%)	8 (7.61%)	9 (8.57%)	0.05,0.324
Total, n (%)	56 (53.33%)	40 (38.09%)	9 (8.57%)	105 (100%)	

P=0.000, α=0.05, p value≤α, r= 0.231

Table 6: Reasons for conversion to open cholecystectomy

Reason	No. of patients	patients %
Inability to create pneumoperitoneum	5	0.5
CBD injury	2	0.11
Cancer of the gallbladder	1	0.05
Polyps of the gallbladder	1	0.05
Hemorrhage	3	0.16
Spilled stone	2	0.11
Choledochoduodenal fistula	5	0.33
Inadequate visualization of structures	4	0.64
Total	9	

Conversion to open surgery occurred in 9 patients (8.57%), of which 3 (2.85%) had no inflammation and 6 (5.711%) had acute inflammation of the gallbladder.

The reasons for conversion to open cholecystectomy are summarized in Table-2 and figures-1-3. The most common reason for conversion was the inability to define the anatomy in Calots triangle (4/3.80%); The other cases of conversion (5/4.76%) involved bleeding from cystic artery (n = 3), common bile duct injury (n = 2), cancer of the gallbladder (n = l), polyps of the gallbladder (n = l), cholecystoduodenal fistula (n = 5/), spilled stone (n=2), and inadequately created pneumoperitoneum (n = 5). There were no cases of injury to major vessels or death [Table-4 -6].

Table 7: Multivariate logistic regression of conversion risk factors of total patients who underwent laparoscopic cholecystectomy

Variables	Coefficient	Standard error	Odds ratio (95% CI)	p value
Constant	- 4.584	0.42	—	<0.001
Age Years				
≤ 40	0		1	
41-60	0.852	0.463	2.27 (0.96-5.86)	<0.001
≥ 60	1.734	0.876	6.73 (2.40-13.14)	<0.001
Presence of Inflammation				
yes	1.986	0.321	7.86 (4.469-11.834	<0.001
No	0		1	
Previous abdominal Surgery				
No	0		1	
Lower	- 0.769	0.328	0.51 (0.029- 0.098)	0.029
Upper	1.342	0.452	4.87 (1.53-9.98)	0.002

The various preoperative characteristics correlating with conversion were shown in Table 7. Significant predictors of conversion based on univariate analysis were male gender (p = 0.027), higher age (p = 0.001), , previous upper abdominal surgery (p < 0.001), and severity of inflammation.

There was also relationship between the likelihood of conversion and BMI (p = 0.03), cardiovascular disease (p = 0.04), hypertension (p = 0.02), or history of acute cholecystitis or pancreatitis (p = 0.05). Multivariate analysis with a multiple logistic regression model showed that the significantly independent predictive factors for conversion were increased age, severity of inflammation, and previous upper abdominal surgery (Table-7). Predictors of conversion to open cholecystectomy were age >60 years (OR, 4.74; 95% CI, 2.08–0.67; P < 0.01), severity of inflammation (OR, 7.07;95% CI, 4.49–11.14; p < 0.01), and previous upper abdominal surgery (OR, 3.36;95% CI, 1.49–7.57; P = 0.002). The same analysis restricted to the patients with inflamed gallbladder showed that the following factors were predictive of conversion to open cholecystectomy: male gender (p = 0.05), increasing age (p = 0.05), elevated WBC count (p = 0.05), fever (p < 0.001), total bilirubin >1.2 mg/dl (p = 0.033), aspartate transaminase >60 U/L (p < 0.001), alanine transaminase >60 U/L (p = 0.002), degree of inflammation (p = 0.05), history of diabetes (p < 0.001), and previous upper abdominal surgery (p = 0.027) .

Multivariate analysis with a multiple logistic regression model showed that the significantly independent predictive factors for conversion in patients with inflamed gallbladder were male gender (p = 0.05), increased age (p = 0.05), severity of inflammation (p = 0.0048), fever (p = 0.009), and elevated WBC count (p = 0.05).

Table 8: Comparison of Scores from Both Scoring Systems

Variables	Mean± SD		P value
	RG -15 (Randhawa)	World Society of Emergency Surgery -WSES-WG-10	
Operative-1	4.81±2.63	2.86±2.54	≤ 0.01
Difficult Group-2	6.64±2.74	3.98±2.11	≤ 0.01
Difficult Group-3	8.59±2.4	6.47± 3.63	≤ 0.01
Overall	7.52±2.95	6.17±2.38	≤ 0.01

Table-8, advocated that the RG-15 [Randhawan] was more accurate to predict the conversion as compared to WG-10, but it was found significant.

Discussion

Many centers around the world used the LC more frequently than classical cholecystectomy (CC) due to low invasiveness and safety of the surgeries performed, reduction of postoperative complications, faster recovery, and significantly shorter hospital stay [38]. However, due to certain factors, there is occasionally a need to abandon the previously planned laparoscopic procedure and perform classic cholecystectomy [43].

In the present study all included patients, aged 18-80 years, 66 males and 39 females were assessed by the two preoperative scoring systems for the conversion of LC to OL at Hind Institute of Medical Sciences, Barabanki, UP. It was observed that age and sex of the respondents, similar as in the studies of other authors. [15,41,].

Many previous studies reported about potential risk factors. A study advocated the statistically significant factors for unplanned laparotomy, included acute cholecystitis, choledocholithiasis, emergency surgery, diabetes, hypertension, heart disease, neurological disease, and, to a lesser extent, anatomical uncertainty. Factors such as chronic cholecystitis, peritoneal adhesions, patient's status after ERCP, and status after pancreatitis were not statistically significant as potential conversion factors [42]. In addition, other authors also took the following into account: patient's BMI , thickness of the gallbladder wall , previous abdominal surgery , increased alkaline phosphatase activity and bilirubin levels, elevated white blood cell count , elevated body temperature, and the American Society of Anesthesiologists score above 3 [41,43]. Limited experience of a medical doctor performing LC is also considered as a statistically significant conversion factor [5,44]. Our study observed the risk factors for conversion as gallbladder wall thickness ≥ 4 mm, Leucocyte count ≥ 10.000µl, previous attack of acute cholecystitis, obesity, male sex which were also concordant with the previous studies.

The multivariate analysis by logistic regression methods were carried out in a study which identified the factors responsible for the risk of unplanned laparotomy and found the optimal model which was useful for risk management during LC procedures. This was used as the so-called early prediction model [15]. A few Studies conducted in this area propose various point or predictive models regarding the likelihood of conversion and proposed to assess the risk of conversion from laparoscopic to open cholecystectomy [17]. Scores included such variables as male gender, abdominal tenderness, previous upper abdominal surgery, thickened gallbladder wall, aged ≥ 60, and the presence of acute cholecystitis [4]. A study developed an equation to predict the conversion based on statistically significant factors, namely, male sex, low serum albumin, elevated leukocytes, ultrasound pericholecystic fluid, diabetes, and elevated total bilirubin [25].

A similar study had developed a predictive model graphically illustrated with four probability nomograms that allowed one to predict the conversion. The model used statistically significant variables, such as previous epigastric surgery, obesity, gallstone disease, thickening of the gallbladder wall, and a stone in the gallbladder neck [41]. The results of the previous studies had revealed the following factors which were statistically significant: age (the chance of unplanned laparotomy increases 1.05 times every year), sex (in men the chance of an unplanned laparotomy was 2.44 times higher than in women), the occurrence of neurological diseases (the chance of an unplanned laparotomy is 5.26 times greater), and diabetes (1.9 times greater chance of unplanned laparotomy) [44]. Similar results in this respect were also observed in our study like previous upper abdominal surgery 1.342±0.452; odds ratio was 4.87 (1.53-9.98).

A few studies assessed the role of gender in the results of surgery and the outcome of laparoscopic cholecystectomy, concluded that male gender was not an independent risk factor for laparoscopic conversion and perioperative complications [25, 28]. The researcher only pointed out a longer operation time in men (72.48 ± 28.50) than in women (65.46 ± 24.83, $p < 0.001$) . The presented results may be a consequence of the unequal distribution of the studied groups of women and men (32.8% vs. 67.2%) [39]. This study results were also accordant with the above, it was observed that the men (73.62± 25.87) and women (67.32± 27.55).

Perioperative factors that influence the risk of unplanned laparotomy immediately before or during the procedure were also analyzed in this study. The most important included acute cholecystitis, the presence of peritoneal adhesions, GB Wall thickness≥ 4mm,leucocyte count ≥ 10,000µl and chronic cystitis, and fistula .The study results particularly predictors/ factors were similar with many previous studies [33,42,45]. The use of the logistic regression model in the presented study allowed for the creation of a formula to estimate the probability of unplanned laparotomy in future patients. It was observed that the age ≥ 60 years was having coefficient of 1.734 ±0.876, and odds ratio was 6.73 (2.40-13.14); presence of inflammation was having coefficient of 1.986 ± 0.321, and odds ratio was 7.86 (4.469-11.834). Identifying patients with significant conversion factors can significantly minimize the adverse effects of attempting laparoscopy. This could provide the basis for enabling hospitals to better plan treatments and efficiently managed their medical staff resources. A similar study was also used multivariate logistic regression, created a model that was useful tool for hospitals to determine their own risk threshold [43].

In our study, we used two intraoperative scoring or grading systems for the degree of difficulty during laparoscopic cholecystectomy, presented by Randhawa JS, Pujahari AK [2], and Nassar AHM. et al[4] but there are also other intraoperative scoring or grading system for the degree of difficulty during laparoscopic cholecystectomy as presented by Vivek et al. [15], where some of the operative predictors were similar to the present study as our prediction/ conversion rate was 8.57% .

In our study it was found, that at the preoperative score of RG-7.52, & WG-6.17 (mean cut off score was ≥ 6.84), the sensitivity and specificity for predicting easy cases were 88.2% and 73.8%, respectively and the prediction was true in 88.6% of easy cases and 68.5% of difficult cases. The study by Gupta et al. showed at the preoperative score of ≥ 5, the sensitivity and specificity for predicting easy cases were 95.47% and 73.68%, respectively and the such prediction was true in 90.00% of easy cases and 88.00% of difficult cases[45].

In our study, the conversion to open cholecystectomy was done in a total of nine cases, out of which 8/88.88% of cases were in the extreme intraoperative grade. None of the patients in the easy group but only one was in the difficult group which intraoperative graded for converted to open cholecystectomy. So, the conversion to open cholecystectomy was significantly higher in difficult cases as per intraoperative grade as compared with easy cases ($p<0.05$). The diagnostic analysis of the intraoperative grading scale (easy vs difficult) in detecting the conversion to open cholecystectomy showed a sensitivity of 100.00% (95% CI: 66.37% to 100.00%), with a specificity of 53.12% (95% CI: 42.66% to 63.39%), and an accuracy of 57.16% (95% CI: 47.13% to 66.77%).

The study has several limitations. Firstly, there are slight differences in the homogeneity in the study groups in terms of age and sex. Another limitation was small sample size , which may lead to a limited ability to correctly classify the preoperative diagnosis and makes the analyzed group very heterogeneous. Finally, this is a single-hospital study that limits the possibility of generalizing the results, and analyzing a random sample of successful laparoscopic cholecystectomies instead of the entire population is another limitation in itself. The formulae obtained from logistic regression should also be validated in the future on a different sample of respondents.

Conclusions

The conducted research revealed many significant risk factors related to conversion. LC is the surgery of choice for mild gallbladder disease. However, when the grading/degree of difficulties for doing a laparoscopic cholecystectomy and determining the severity of cholecystitis, this intraoperative scoring system was effective and accurate. Additionally, it signified the need for conversion from laparoscopic to open cholecystectomy in cases of severe cholecystitis. With its use, the postoperative course could be predicted and appropriate counseling concerning the outcomes could be provided. Additionally, in our study, the preoperative scoring systems RG-15 (mean cut-off score ≥ 6.84) were evaluated as effective and consistent in determining the difficult laparoscopic cholecystectomy. The conversion rate from laparoscopic cholecystectomy to open cholecystectomy was 8.57%. Some of the risk factors for conversion are gallbladder wall thickness ≥ 4 mm, Leucocyte count ≥ 10.000µl, previous attack of acute cholecystitis, obesity, male sex.

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