DOI: 10.21608/ASJS.2023.298749

Validation of Nassar Difficulty Grading Scale in Predicting Difficult Laparoscopic Cholecystectomy

Sameh Hashish, MD, M.Sc
Department of Hepatobiliary & Liver Transplant Surgery, National Liver Institute, Menofia University, Menofia, Egypt

Background: Cholelithiasis is a common disease & laparoscopic cholecystectomy is the gold standard treatment for cholecystitis. There is a need for a preoperative scoring system that can accurately predict difficult laparoscopic cholecystectomies to assist in selection of patients as a day case surgery, to assign the procedure to a surgeon with the appropriate experience and to counsel the patient throughout the consent process.

The aim of this study: To validate Nassar preoperative scoring system that would predict difficult laparoscopic cholecystectomies. conversion to open cholecystectomy was considered the primary end point of difficulty.

Patients and methods: This was a prospective cohort study to patients who underwent laparoscopic cholecystectomies at our department of surgery, King Abdul-Aziz specialized hospital (KAASH) at Taif, Ministry of health, Saudi Arabia between April 2020, and April 2022.

Results: 1357 patients underwent laparoscopic cholecystectomy whether elective or emergent. After admission of patients to operative theatre for laparoscopic cholecystectomy, 478 (35.2%) of patients were converted to open to complete the procedure. Patients & percentages of difficult operations were classified according to Nassar risk score from 0 to 19 & then, subdividing all risk scores into 3 subgroups: low, medium & high-risk score. It was found that 56% of preoperative high-risk patients (7-19) had difficult operations, while 24.4% of medium-risk patients (2-6) had difficult operations & only 10.1% of patients of Low-risk group had difficult procedures.

Conclusion: Nassar difficulty grading scale is considered straightforward, clinically & surgically applicable, and easy to use preoperative scoring system to predict difficult laparoscopic cholecystectomies.

Key words: Cholecystitis, difficult cholecystectomy, Nassar score.

Introduction

Cholelithiasis is one of the most frequent diseases that affect the digestive system. Gallstone prevalence varies with age, gender, ethnicity, and other factors. It varies greatly from area to area.[1]

Biliary colic and cholecystitis are common diseases, and many surgeons are experienced in treating them. According to the Tokyo Guidelines 2018 (TG18), laparoscopic cholecystectomy (LC) is a gold standard treatment for cholecystitis.[2]

Laparoscopic cholecystectomy (LC) benefits, such as its minimally invasive nature, lower postoperative pain, improved cosmesis, shorter hospital stay, and quick recovery, are widely proven.[3]

Most laparoscopic cholecystectomies are simple and straightforward when carried out by qualified surgeons using a standard technique. However, some surgical findings can make different steps of the procedure more difficult, adding to the operation's complexity and raising the likelihood of unfavorable outcomes.[4]

Age, male gender, previous acute cholecystitis attacks with fever and leukocytosis, obesity, prior abdominal surgery, signs of acute cholecystitis, and specific ultrasonographic findings, such as thick wall of gall bladder, distended gall bladder, pericholecystic fluid collection, impacted GB neck stone, etc., are considered risk factors that make laparoscopic surgery difficult.[5]

Patients undergoing difficult laparoscopic cholecystectomy (DLC) require more operative time and more blood loss. These challenges put an unexpected load on surgical nurses, anesthesiologists, and surgeons. Additionally, DLC may have negative effects on patients including conversion to open surgery or an increase in intraoperative and postoperative complications.[6]

To enable qualitative analyses and outcome comparisons, it is crucial to standardize documentation and communication along with risk-adjusted measurements. A scoring/grading system that is straightforward, clinically, and surgically applicable, and easy to use is necessary for precise and reproducible categorization of the severity of gallbladder (GB) disease.[7]

This scoring system is intended to help with patient selection for day case surgery, preoperative surgical planning optimization (E.g., assigning the procedure to a surgeon with the appropriate training), and patient counseling throughout the consent process. Future study outcomes could likewise be risk-adjusted using the score.[8]

Numerous research has suggested pre-operative scoring systems for identifying cholecystectomy cases that would be difficult. Despite being related

to several measures of intra-operative difficulty, the majority of scoring systems lack objective criteria of the difficulty experienced during a cholecystectomy.[5]

Moreover, these studies also either lacked external validation or had limited sample sizes. Other predictive scores estimated the possibility of converting from Laparoscopic cholecystectomy to open surgery. This, however, varies according to the surgeon's expertise and the availability of the necessary equipment. Conversion to open surgery is currently less relevant than it was when the technique was first introduced because different techniques and approaches are now available, enabling the continuation of a laparoscopic approach where difficulties develop.[8]

Nassar difficulty grading scale

Nassar et al. described a difficulty grading system based on intra-operative data.9 The comprehensiveness and ease of use of this grading system led to its wide use in several research evaluating the suitability of certain procedures and of the intra- and postoperative consequences of laparoscopic cholecystectomy. They recently discovered that worse clinical outcomes, such as prolonged hospital stays, postoperative morbidity, conversion to open surgery, and 30-day mortality, were related to higher operative difficulty scores.[10]

After that, in a study by Nassar et al. (2020),[8] they suggested and validated a scoring system that predicts the difficulty of a laparoscopic cholecystectomy using preoperative data.[11]

Intraoperative findings of the gallbladder, cystic pedicle, and any associated adhesions were graded using this scale **(Table 1).** This grading system is intended to be applied as an overall description of the operative conditions detected, and the final overall grade should be determined by taking the worst factor detected in each individual aspect of either the "Gallbladder," "Cystic Pedicle," or "Adhesions". The scale was initially announced in 1995 with grades 1-4 and modified later in 1996 to include a grade 5.[8]

Higher intraoperative difficulty scores were detected to be related to worse clinical outcomes, such as conversion to open surgery, increased postoperative complications with long hospital stays, and increased 30-day mortality.[10]

Aim of the study

The aim of this study was to validate Nassar preoperative scoring system that would predict difficult laparoscopic cholecystectomy. medical records of 1357 patients with laparoscopic cholecystectomy in our unit were analyzed prospectively from April 2020 till April 2022.

Patients and methods

This was a prospective cohort study to patients who underwent laparoscopic cholecystectomy whether elective or emergent who were admitted to our department of surgery, King Abdul-Aziz specialized hospital (KAASH) at Taif, Ministry of health (MOH), Saudi Arabia, in the period between April 2020 and April 2022. each patient signed preoperative consent for the use of related prospective database for research purposes.

Inclusion & exclusion criteria

Our inclusion criteria were all patients who underwent laparoscopic cholecystectomy whether elective or emergent with postoperative histopathology that proven that it was of benign nature either calcular cholecystitis or gall bladder polyp. Each patient for laparoscopic cholecystectomy were assessed preoperatively by anesthesia team and categorized according to the American Society of Anesthesiologists (ASA) physical status classification system (ASAPS). **(Table 2)**

patients with postoperative histopathology that proven to have incidental gall bladder carcinoma, those previously managed in other surgical departments and then transferred to our ward, all those who underwent Ultrasound-guided percutaneous cholecystostomy as well as those who underwent laparoscopic cholecystectomy performed with other laparoscopic intervention in same setting were excluded.

Data collection

Data was extracted from preoperative and operative data records, post-operative, and follow-up files.

Patient data:

I- Preoperative variables:

A- Demographic findings:

- Age.
- Gender: male/female.
- Occupation.
- Residence.
- Special habits of medical importance.

B- History & clinical examination:

- Symptoms and physical signs.
- Past history including co-morbidity, previous surgical history & drug history.
- **Laboratory study:**

1. Complete blood picture (CBC).

2. Liver function tests (bilirubin, total protein, albumin), liver enzymes including Aspartate transferase (AST), Alanine transferase (ALT), Alkaline phosphatase (ALP), Gamma glutamyl transferase (GGT).
3. Coagulation profile: prothrombin time (PT), concentration (PC) & INR.
4. Kidney function tests (Urea, creatinine).
5. Serum electrolytes & blood gases.

- **Imaging studies**

1. **Ultrasonographic findings (U/S):** was the routine diagnostic imaging method in all patients to detect gall bladder (GB) stones (the most sensitive & specific imaging for GB stones detection), GB wall thickening, exclusion of dilated intrahepatic biliary radicles (IHBR) OR common bile duct (CBD) dilatation & presence of any CBD stones or any pancreatic abnormality.
2. **Triphasic abdominal C.T.:** was not routinely done in all patients. It was done for patients above 60 years old to exclude malignancy, patients with complicated acute cholecystitis suspected by US, patients with GB polyp to confirm diagnosis exclude malignant nature & invasion & to exclude pancreatic necrosis & collections in patients who presented with acute biliary pancreatitis.
3. **MRI Abdomen:** also, was not routinely done in all patients. It was done to confirm diagnosis and assess biliary or pancreatic complications if suspected by US abdomen & assess CBD diameter
4. **Endoscopic retrograde cholangiopancreatography (ERCP):** was done to confirm diagnosis and assess biliary complications e.g., CBD stones, strictures, or fistulae with curative intervention e.g., sphincterotomy, stone extraction & stenting when indicated.

II- Intra-operative variables:

A. Operative time.

B. B. Conversion from laparoscopic to open cholecystectomy: Our study depended on conversion from laparoscopic to open cholecystectomy as the primary end point for technical difficulty.

Technical issues

The customary surgical technique in our department for laparoscopic cholecystectomy was as follows; first, after anesthesia induction and intubation, pneumoperitoneum was achieved by insufflation of abdomen to 15 mmHg with carbon dioxide using closed access (Veress needle) technique. then, four small incisions were made in the abdominal wall to insert trocars (One supraumbilical, one subxiphoid, and two right subcostal). using a laparoscope (Camera) and instruments, the gallbladder was retracted up & to the right side across the liver. This permitted the region of the Calot's triangle to be exposed. To acquire the critical view of safety, a careful dissection was performed above the level of Rouviere's sulcus **(Figure 1).** This view was obtained by (1) The Calot's triangle must be cleared of fibrous and fatty tissue, (2) only two tubular structures must enter the gallbladder's base, and (3) the lower third of gallbladder must be separated from the liver for proper visualization of the cystic plate. The operating surgeon continued in confidence for isolation of the cystic artery and duct once this critical view has been satisfactorily achieved. Then, the cystic artery and cystic duct were carefully clipped and transected respectively in most cases. After that, the gallbladder was totally separated from the liver bed by electrocautery. Hemostasis was done after deflation of the abdomen to 8 mmHg for two minutes. By using this technique, any missed potential venous hemorrhage that could be tamponaded by the increased intra-abdominal pressure (15 mmHg) could be avoided. Then, an endo bag was used to extract the gallbladder from the abdomen. removal of all trocars is performed under direct visualization. Finally, port sites were closed including fascial closure of trocar sites that were more than 5 mm to prevent postoperative incisional hernias.

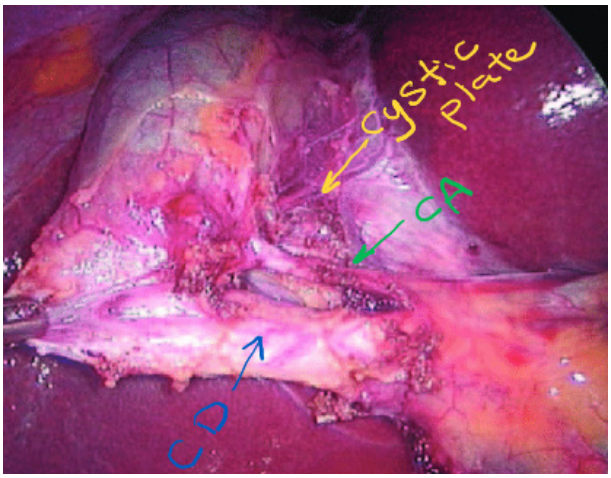

Fig 1: The critical view of safety during laparoscopic cholecystectomy.

Statistical analysis

Statistical analysis was done using the SPSS software (v.20, IBM, New York, USA). For categorical variables, Fisher's exact or Chi-square tests were used to compare the two patient groups, and the

Mann-Whitney U test was employed for continuous non-normally distributed data. To compare the two groups using multivariate analysis, a logistic regression test was applied. Statistics were considered significant when P values were < 0.05.

Results

From April 2020 to April 2022, one thousand, three hundreds & fifty-seven patients who underwent laparoscopic cholecystectomy whether elective or emergent were admitted to department of surgery, King Abdulaziz specialized hospital (KAASH) at Taif, Ministry of health (MOH), Saudi Arabia. **(Table 3).**

The mean age of patients was 48 ± 14 years with a range from 16 – 86 years. Nine hundreds & seventy-three patients were female representing the majority of cases (71.7%), while male patients were 384 cases (28.3%).

The most common ASA physical status was ASA 2 representing 57.4% (779) of patients, while the least common ASA status was ASA 4-5 in only 18 patients (1.3%).

In our department, the elective cases were significantly less than emergent ones due to holding of elective surgical list from March 2021 till January 2022 due to the Covid-19 pandemic. So, the majority of cases in this study was emergent with 38.4% (521) of patients diagnosed primarily as CBD stones, 26.8% (363) as acute cholecystitis, 20.7% (281) as biliary colic & 13.7% (186) as acute biliary pancreatitis. Six (0.4%) patients presented with gall bladder polyp indicated for laparoscopic cholecystectomy & proved to be benign by histopathology.

All patients were routinely examined ultrasonographically in whom Thick-walled gallbladder (≥3 mm) was detected in 1191 (87.8%) patients, while 576 (42.4%) patients were detected to have CBD dilatation (>6 mm) that was confirmed by preoperative MRCP that was indicated in those patients & those have elevated liver & biliary enzymes. Preoperative MRCP was done in 768 (56.6%) patients, while preoperative CT abdomen was done in 249 (18.7%) cases. After MRCP, it was found that 14 (1%) patients with dilated CBD > 6 mm was free from intra- & extrahepatic obstruction with no stones detected & all have normal liver profile. All those patients were > 68 years old & the CBD diameter didn't exceed 7.5 mm. So, it was attributed to aging. Preoperative ERCP with\without stenting was performed in 462 (34%) of patients that were highly suspected to have CBD stones or obstruction by either MRCP or CT abdomen.

Four hundreds & forty-three (32.6%) patients had history of previous admissions either at our hospital or any other hospital. Causes of discharge at previous admission were;

1. **Interval for inflammation to subside due to:**
   - ► Mirizzi syndrome in 264 (19.3%) cases.
   - ► Perforated GB or abscess that was managed by percutaneous drainage in 12 (0.9%) cases.
   - ► Complicated pancreatitis in 43 (3.2%) patients.
2. **Pt indicated for 2nd session of ERCP for:**
   - ► stone extraction in 46 (3.4%) cases.
   - ► exclude malignancy due to edematous enlarged ampulla of Vater in 3 (0.2%) cases.

3. According to patient wish in 36 (2.7%) patients due to special or social causes.

4. Infections that needed treatment before surgery e.g., chest, urinary infection, etc. in 23 (1.7%) cases.

5. Unidentified cause in 16 (1.2%) cases.

Most patients (1033) were admitted as emergent cases representing 76.1% of admitted cases, while the percentages of elective & delayed admitted cases were 10.2% & 13.7% respectively.

Ninety-eight (7.2%) patients were admitted as day-case surgery during the period of this study, while 792 (58.4%) patients were admitted at the 3rd day or more after admission.

The mean operative time was 94.3 min (range 37-343). This was 74.6 min (37-213) for elective and 104.7 min (41-343) for emergency cases respectively (P value = 0.001)

In univariate analysis, significant differences in demographic data of patients were found in patients' gender (P value = 0.021), those who had Thick-walled gallbladder (P value = 0.003), patients underwent Preoperative ERCP (P value = 0.041) and hospital admission type (P value = 0.002).

After admission of patients to OR for laparoscopic cholecystectomy, 478 (35.2%) of patients were converted to open to complete the procedure, So, in this current study, conversion to open cholecystectomy was considered the primary end point of difficulty. **(Table 4)**

It was found that only 38 cases (13.4%) of the 284 patients who were < 40 years old had difficult operations, while 92.1% (440 patients) of difficult operations occurred in patients > 40 yrs old. The most risky group for difficult procedure was found in patients > 65 years old as 64.3% (72 patients) of

them (112) had difficult lap choles.

Two hundreds & sixty-nine male patients had difficult operation representing 70.1% of the male patients (384), while only 209 (21.5%) of female patients had difficult lap choles.

Despite the low number of patients with ASA score 4-5 (18 cases), it was found that 11 of them had difficult lap choles representing 61.1%. However, only 24.1% of patients with ASA score 1 had difficult operations.

As expected, 58.5% of patients who were admitted as acute cholecystitis had difficult operations unlike those who admitted with acute pancreatitis, biliary colic & CBD stone cases that had lower percentages of difficult lap choles (28.5%, 25.3% & 27.1% respectively). Also, it was noted that the procedure in all six cases who admitted for lap chole for GB polyp was accomplished laparoscopically & was easier than other diagnosis.

Four hundreds & fifty-seven (38.4%) patients with thick GB wall (≥3 mm) have difficult procedures as 363 cases of them were acute cases. While 235 (40.8%) patients of those had CBD dilation (>6 mm) had difficult lap choles as some of them (126 cases) had Mirizzi type I.

Regarding the preoperative imaging & intervention, it was found that 204 (82%) cases of those underwent preoperative CT abdomen had difficult lap choles as most of them was proved to have acute complicated cholecystitis by the CT as expected by routine US abdomen. Moreover, 311 patients (40.5%) of those who underwent preoperative MRCP had difficult procedures. One hundred & sixty-two (35.1%) cases of those who underwent ERCP with/without stenting had difficult procedures.

It was found that 267 (60.3%) patients with difficult lap choles had history of previous admission for calcular GB disease either in our hospital or any other hospital. Also, 377 (36.5%) of 1033 patients who admitted as emergent cases had difficult operations compared to 64 (34.4%) of 186 patients with delayed admissions to OR had difficult procedures.

As most of patients admitted as emergent was admitted for surgery at the 3rd day or more, 348 (44%) patients of them had difficult lap choles.

In multivariate analysis, significant differences were detected in Age (P value = 0.001), gender (P value = 0.012), primary diagnosis (P value = 0.011), Thick-walled gallbladder (P value = 0.027), Previous admissions (P value = 0.011), Preoperative CT abdomen (P value = 0.001), Preoperative MRCP (P value = 0.032) & type of admission (P value = 0.001).

As shown in **(Table 5),** all patients in this study were categorized according to Nassar difficulty grading scale;

After that patients & percentages of difficult operations were classified according to the preoperative risk score from 0 to 19 & then, subdividing all risk scores into 3 subgroups: low, medium & high-risk score **(Table 6).**

As shown in table (6), 297 (56%) of preoperative high-risk patients (7-19) had difficult operations, while 166 (24.4%) of medium-risk patients (2-6) had difficult operations. Only fifteen (10.1%) patients of the Low-risk group had difficult procedures.

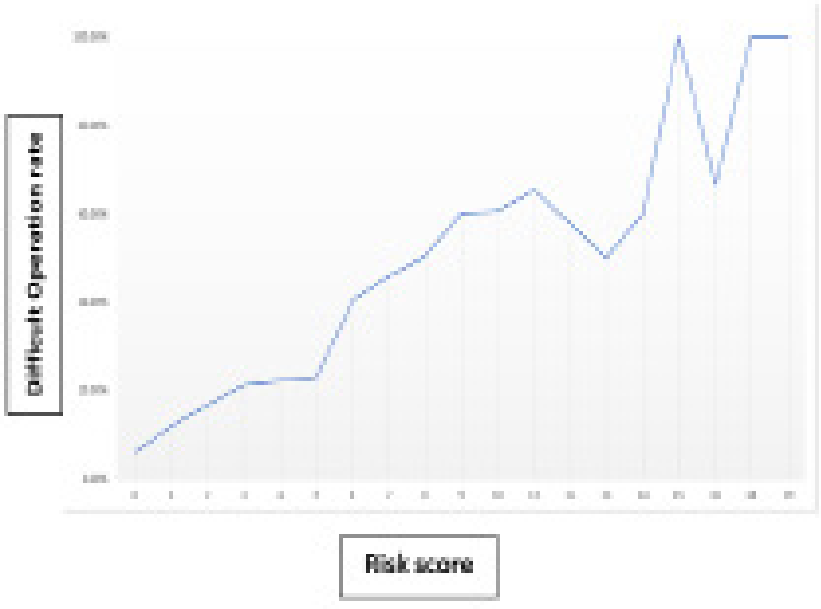

Fig 2: A curve showing relation between the risk score and percentage of difficult operations.

Table 1: Preoperative risk scale for difficult laparoscopic cholecystectomy[8]

Variable	Point
Age (years)	
< 40	0
> 40	1
Gender	
Female	0
Male	1
ASA classification	
1	0
2	1
3	2
4-5	7
Main diagnosis	
Pancreatitis	0
Biliary colic	0
CBD stone	1
Cholecystitis	4
Thick gallbladder wall (≥3 mm)	
No	0
Yes	2
Dilated CBD (>6 mm)	
No	0
Yes	1
Preoperative ERCP	
No	0
Yes	1
Type of admission	
• Elective	0
• Delay	1
• Emergency	2

Low risk = 0-1, **intermediate risk** = 2-6, **High risk** = 7-19.

Table 2: The latest version of the American Society of Anesthesiologists (ASA) physical status classification system (ASAPS)[12]

ASA score	Physical status
1	Physically normal healthy patient that is fit, non-obese (BMI < 30), a non-smoker with good tolerance to exercise
2	patient with mild systemic disease e.g., patient without any functional limitations and well-controlled disease (e.g., treated hypertension (HTN), obesity with BMI < 35, frequent social drinker, or cigarette smoker).
3	patient with a severe systemic disease which is not life-threatening. E.g., patient with some functional limitations due to disease (e.g., poorly treated HTN or DM, morbid obesity, chronic renal failure, a bronchospastic disease with intermittent exacerbation, stable angina, implanted pacemaker).
4	patient with a severe systemic disease that is a constant threat to life e.g., patient with functional limitations from severe, life-threatening disease (e.g., poorly controlled COPD, unstable angina, symptomatic CHF, recent (less than three months ago) myocardial infarction or stroke
5	A moribund patient who is not expected to survive without the operation. The patient is not expected to survive beyond the next 24 hours without surgery e.g., ruptured abdominal aortic aneurysm, massive trauma, and extensive intracranial hemorrhage with mass effect.
6	A brain-dead patient whose organs are being removed with the intention of transplanting them into another patient.

The addition of "E" to the ASAPS (e.g., ASA 2E) denotes an emergency surgical procedure. The ASA defines an emergency as existing "when the delay in treatment of the patient would lead to a significant increase in the threat to life or body part."

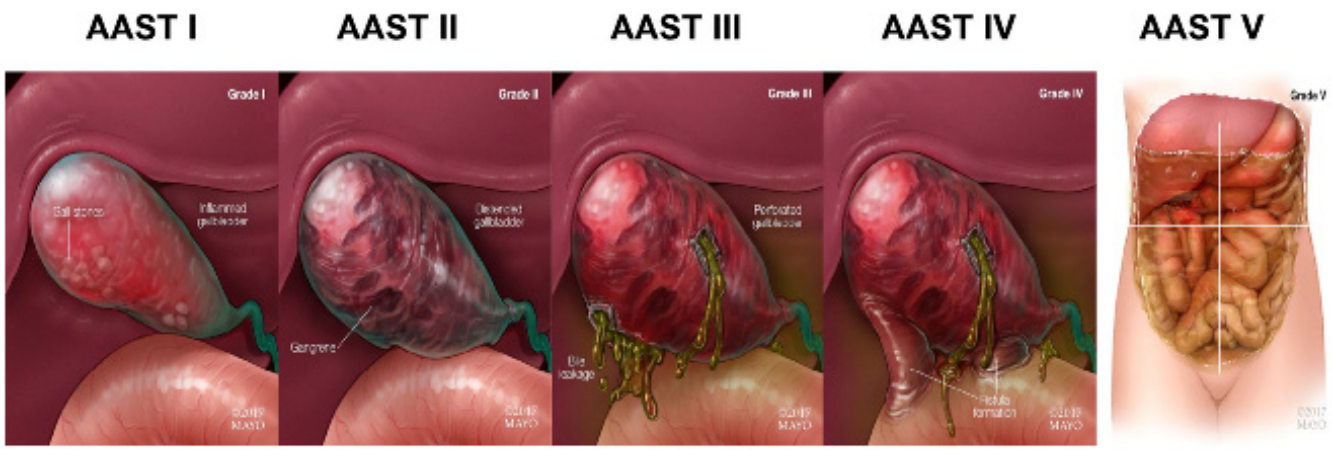

Fig 3: Grade descriptions of severity of acute cholecystitis according to The AAST EGS.[39]

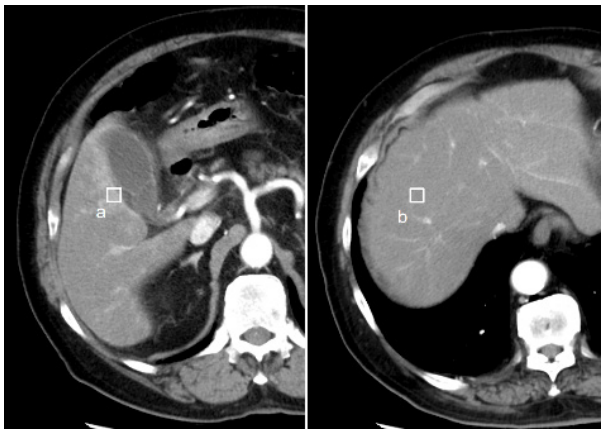

Fig 4: Square area of interest for two points: at the liver parenchyma close to the gallbladder (Segment V) (a) and at another point at the same depth (Segment VIII) (b), excluding vessels.[47]

Table 3: Demographic data of the patients

	Number (N°)	Percentage (%)	P value
Total number of patients	1357	100%	
Age (year)			
Mean ± SD	48 ± 14		0.13
Range (year)	16 - 86		
Sex			
Female	973	71.7%	0.021
Male	384	28.3%	
ASA classification			
1	464	34.2%	
2	779	57.4%	0.78
3	96	7.1%	
4-5	18	1.3%	
Primary diagnosis			0.66
Pancreatitis	186	13.7%	
Biliary colic	281	20.7%	
CBD stone	521	38.4%	
Cholecystitis	363	26.8%	
GB polyp (single, > 1cm)	6	0.4%	
Thick GB wall (≥3 mm)			
No	166	12.2%	0.003
Yes	1191	87.8%	
Dilated CBD (>6 mm)			
No	781	57.6%	0.53
Yes	576	42.4%	
Dilated CBD with free MRCP due to aging	14	1%	
Previous admissions			
No	914	67.4%	0.078
Yes	443	32.6%	
Preoperative CT abdomen			
No	1108	81.7%	0.84
Yes	249	18.3%	
Preoperative MRCP			
No	589	43.4%	0.063
Yes	768	56.6%	
Preoperative ERCP			
No	895	66%	0.041
Yes	462	34%	
Type of admission			
Elective	138	10.2%	0.002
Delayed	186	13.7%	
Emergency	1033	76.1%	
Admission for OR			
0 days	98	7.2%	
1 days	294	21.7%	0.09
2 days	173	12.7%	
+3 days	792	58.4%	
Operative time (min)			
Mean (range)	94.3 (37-343)		0.001
Elective	74.6 (37-213)		
Emergent	104.7 (41-343)		

Table 4: Relations between demographic data of patients and difficult operations

	Nº	Difficult operations (%) 478 (35.2%)	P value
Age (years)			
<40	284	38 (13.4%)	0.001
40–49	448	147 (32.8%)	
50–64	513	221 (43.1%)	
+65	112	72 (64.3%)	
Sex			
Female	973	209 (21.5%)	0.012
Male	384	269 (70.1%)	
ASA classification			
1	464	112 (24.1%)	0.89
2	779	308 (39.5%)	
3	96	47 (49%)	
4-5	18	11 (61.1%)	
Primary diagnosis			
Pancreatitis	186	53 (28.5%)	0.011
Biliary colic	281	71 (25.3%)	
CBD stone	521	141 (27.1%)	
Cholecystitis	363	213 (58.7%)	
GB polyp (single, > 1cm)	6	0 (0%)	
Thick GB wall (≥3 mm)			
No	166	21 (12.7%)	0.027
Yes	1191	457 (38.4%)	
Dilated CBD (>6 mm)			
No	781	243 (31.1%)	0.19
Yes	576	235 (40.8%)	
Dilated CBD with free MRCP due to aging	14		
Previous admissions			
No	914	211 (23.1%)	0.011
Yes	443	267 (60.3%)	
Preoperative CT abdomen			
No	1108	274 (24.7%)	0.001
Yes	249	204 (82%)	
Preoperative MRCP			
No	589	167 (28.4%)	0.032
Yes	768	311 (40.5%)	
Preoperative ERCP			
No	895	316 (35.3%)	0.94
Yes	462	162 (35.1%)	
Type of admission			
Elective	138	37 (26.8%)	0.001
Delay	186	64 (34.4%)	
Emergency	1033	377 (36.5%)	
Admission for OR			
0 days	98	27 (27.6%)	0.062
1 days	294	57 (19.4%)	
2 days	173	46 (26.6%)	
+3 days	792	348 (44%)	

Table 5: Preoperative risk scale for difficult lap choles & number of patients in each score

	Point	Nº of patients
Age (years)		
<40	0	284
>40	1	1073
Sex		
Female	0	973
Male	1	384
ASA classification		
1	0	464
2	1	779
3	2	96
4-5	7	18
Primary diagnosis		
Pancreatitis	0	186
Biliary colic	0	281
CBD stone	1	521
Cholecystitis	4	363
GB polyp (single, > 1cm)		6
Thick GB wall (≥3 mm)		
No	0	166
Yes	2	1191
Dilated CBD (>6 mm)		
No	0	781
Yes	1	576
Dilated CBD with free MRCP due to aging		14
Preoperative ERCP		
No	0	895
Yes	1	462
Type of admission		
Elective	0	138
Delay	1	186
Emergency	2	1033

Table 6: Classification of patients & percentages of difficult operations according to the preoperative risk score

Risk score	Nº (%)	Difficult operations (%)
0	49 (3.6%)	3 (6.1%)
1	99 (7.3%)	12 (12.1%)
Low-risk subtotal	148 (10.9%)	15 (10.1%)
2	108 (8%)	18 (16.7%)
3	169 (12.5%)	36 (21.3%)
4	152 (11.2%)	34 (22.4%)
5	134 (9.9%)	31 (23.1%)
6	116 (8.5%)	47 (40.5%)
Medium-risk subtotal	679 (50.1%)	166 (24.4%)
7	111 (8.2%)	51 (46%)
8	107 (7.9%)	54 (50.5%)
9	113 (8.3%)	68 (60.2%)
10	97 (7.1%)	59 (60.8%)
11	58 (4.3%)	38 (65.5%)
12	31 (2.3%)	18 (58.1%)
13	2 (0.14%)	1 (50%)
14	5 (0.35%)	3 (60%)
15	1 (0.07%)	1 (100%)
16	3 (0.2)	2 (66.7%)
17	0	0
18	1 (0.07%)	1 (100%)
19	1 (0.07%)	1 (100%)
High-risk subtotal	530 (39%)	297 (56%)

Table 7: Grade descriptions of acute cholecystitis severity according to The Tokyo guidelines.[41]

Grade	Degree	Description
Grade I	Mild	Acute cholecystitis without any organ dysfunction
Grade II	Moderate	**Acute cholecystitis with any one of the following:** • WBC > 18,000/mm3 • tender mass palpable in the upper right quadrant • Symptoms persists >72 hours • Marked local complications (Emphysematous cholecystitis, gangrenous cholecystitis, pericholecystic abscess, hepatic abscess, biliary peritonitis)
Grade III	Severe	**Acute cholecystitis with any organ dysfunction:** • Cardiovascular: Hypotension indicating vasopressors • Neurologic: disturbed consciousness level • Respiratory: PaO2/FiO2 < 300 • Renal: Oliguria, creatinine > 2.0 mg/dL • Hepatic: INR > 1.5 • Hematologic: Platelets < 100,000/mm3

Table 8: Grade descriptions of severity of acute cholecystitis according to The AAST EGS.[39]

Grade	Description	Imaging	Operative
Grade I	Localized inflammation of the gallbladder	• Thickened GB wall • pericholecystic fluid • GB is not visualized	Local inflammatory changes
Grade II	Distended purulent or hydropic, necrotic, or gangrenous gallbladder without iatrogenic perforation	As in Grade I plus air in gallbladder lumen, wall, or biliary tree	Localized inflammatory changes
Grade III	Non-iatrogenic perforation of GB with Localized biloma at RUQ	localized Extraluminal fluid collection limited at RUQ	Local inflammatory changes
Grade IV	• Pericholecystic abscess • bilioenteric fistulae • gallstone ileus	localized Extraluminal fluid collection limited at RUQ	• Pericholecystic abscess • bilioenteric fistulae • gallstone ileus
Grade V	Grade IV plus generalized peritonitis	Free fluid in the peritoneal cavity	As in grade IV plus generalized intraperitoneal free fluid

Table 9: Cholecystitis severity score used for 10-point intra-operative gallbladder scoring system (G10)[42]

Indicators for severity of cholecystitis	Score
Appearance	
Adhesions < 50% of GB	1
Adhesions > 50% of GB	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	
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

Discussion

However, Universal principles of the gallstone treatment have unchanged significantly in recent years, surgical techniques have changed, and laparoscopic cholecystectomy (LC) is currently considered the standard technique for the management of gallstone complications that require surgical intervention.[13]

Since its introduction by P. Mouret in 1987, laparoscopic cholecystectomy (LC) has become the procedure of choice for the management of symptomatic gallstone disease.[14] In addition to its safety and effectiveness, laparoscopic cholecystectomy has several advantages over traditional cholecystectomy, including reduced postoperative pain, a quicker recovery time, an earlier return of bowel function, and a shorter hospital stay.[15]

As LC experience increases worldwide, selection criteria are becoming more flexible. Most of the factors that were considered absolute contraindications to attempting LC, such as morbid obesity and previous upper abdominal surgery, are no longer absolute contraindications. The number of contraindications decreased significantly over time.[16]

Laparoscopic cholecystectomy is a relatively safe procedure and highly effective. Surgeons may encounter many difficulties during the operation, starting with intraperitoneal access, reaching the pneumoperitoneum, adhesolysis, and identifying the correct anatomy. Identification of the intraoperative anatomy especially the critical view of safety, is the most important step in LC. Many complications have been recorded during surgery, including injuries during Adhesolysis, biliary, vascular, and port site complications.[17]

LC is still the technical procedure that, in challenging circumstances, can result in dramatic complications, particularly if the surgeon has to operate an emergency LC for acute cholecystitis & deal with serious inflammation at the cystic pedicle, that increases the operative time, the conversion rate, the risk of bile duct injury and postoperative complications. The difference between emergency and planned LC, however, is insufficient to accurately estimate intraoperative difficulties that may increase the intraoperative risk and promote disorganization of operating team & theatre.[18]

Outcomes of cholecystectomy are variable, particularly with respect to surgical approach and findings, the use of intraoperative cholangiography, conversion to open surgery, operative time, and morbidity including hospital readmission. Due to the significant variety of the patients and the real condition of the gallbladder during surgery, there are numerous variables in the management of cholecystitis that necessitate a specialized strategy. In order to improve outcomes after laparoscopic cholecystectomy, it is important to understand the origin of this variability and take steps to reduce it.[19]

Difficulty of laparoscopic cholecystectomy can be predicted using a preoperative grading system based on history, clinical examination, and radiological findings compared with the score given based on intraoperative difficulties.[20]

The use of a predictive score of surgical difficulty is thus primarily of significance to identify high-risk operations and may be useful to enhance patient counseling, optimize surgical planning and room efficiency, identify patients who may be risky for complications, alter the surgical technique or the surgeon, identify patients who can be cared at outpatient, and choose those for the purpose of resident training.[21]

Despite the many DLC studies that were carried out, there is still no clear agreement on difficulty predictors. Since most research was retrospective, data rely on quality of medical hospital data and its statistics. The concept of DLC is under doubt since it ignores the surgeon's skills, which, in addition to the pathological findings of the gallbladder, are crucial to how long the procedure takes. Only operation conflicts that result in significant prolongation of operative time can be referred to as its predictors. Every surgeon has a different average operation time, which can be increased or decreased by up to one standard deviation. Significant operation prolongation is defined as an operation lasting longer than this range, which is an indication of a severe pathogenic substrate and DLC. DLC is a potential launch point for conversion, but not an inevitable way to conversion.[22]

Planning a laparoscopic surgery requires carefully estimating the risk of conversion or the difficulty of the procedure before the procedure. With the help of precise prediction, highly risky patients may be informed before surgery to make their own decision. Also, surgeons can take their precautions for appropriate time & operation team. Lengthier hospital stays, and more intense postoperative care should be planned for patients who are expected to have a high risk. Moreover, this might make it easier for hospital administration to forecast and plan admissions & ensure vacant beds.[5]

Numerous studies had been done to evaluate the risk of conversion before surgery. Six factors were found to have a significant impact on the risk of conversion in a study by Kama et al. (2001),[23] including male sex, upper abdominal tenderness at the operative time, prior upper abdominal surgery, preoperative ultrasound detected thick gallbladder wall, age > 60 years, and preoperative diagnosis of

acute cholecystitis.

With reported rates ranging from 1% to 15%, conversion from laparoscopic cholecystectomy (LC) to open cholecystectomy (OC) may be essential for many reasons. The length of the hospital stays, the operating time, the complication rates, and the perioperative expenses all increase with open conversion.[24]

Several research studies have evaluated the risk variables for complications after LC or have suggested risk scores for conversion. However, few research directly addressed the topic of technical difficulty, and as a result, their findings are conflicting due to the statistical analysis's use of overly subjective factors as well as the methodology used to identify challenging cases. The majority of current scores assess the risk of converting the procedure from laparoscopic to open. only Sakuramoto et al. (2000),[25] study has depended on the operative time as the primary end point.[21]

In this current study, conversion from laparoscopic to open cholecystectomy have been used as the primary end point for technical difficulty.

In our current study, 1357 patients underwent laparoscopic cholecystectomy whether elective or emergent From April 2020 to April 2022. Four hundred & seventy-eight patients of them (35.2%) had difficult procedures that led to conversion of the laparoscopic procedure to open to accomplish cholecystectomy.

In the current study, the rate of conversion from laparoscopic to open was considered the parameter for evaluating difficult procedures. This corresponds to studies done by Kanakala et al. (2011),[26] & Rosen et al. (2002),[27] who also depended on conversion to open as the difficulty parameter.

While in a study by Gupta et al. (2013),[5] they considered difficult operations that took time > 60 min to accomplish the cholecystectomy. In a study by Randhawa et al. (2009),[28] they also depended on time taken to finish the procedure, but they categorized difficult surgeries into difficult & very difficult. The difficult subgroup included patients with their operations not converted to open, but one of the following: Time taken 60-120 min, bile/ stone spillage or injury to duct. While the very difficult subgroup included those with operations either taking time >120 min or converted to open.

In a study by Nidoni et al. (2015),[1] the overall conversion rate was 6%. Also, in Sharma et al. (2007),[29] study that was done on 200 patients undergoing laparoscopic cholecystectomy, the conversion rate in their study was 4%. This lower conversion rate than in our study may be attributed to the lower number of patients included in their studies & also in our study, most patients was admitted as emergent with gall stone complications due to holding of elective surgeries during Covid-19 pandemic leading to more difficult operations & higher rate of conversion.

Risk for multiple cholecystitis attacks is increased with increasing age that may also be associated with increase in the frequency of upper abdominal surgeries. As a result, the hepatic hilum has a higher incidence of fibrosis and adhesions.[30]

In this current study, 38 cases (13.4%) of 284 patients who were < 40 years old had difficult operations, while 92.1% (440 patients) of difficult operations occurred in patients > 40 yrs old. The most risky group for difficult procedure was found in patients > 65 years old as 64.3% (72 patients) of them (112) had difficult lap choles. A significant difference was found regarding the age in our study (P value < 0.05).

This corresponds to what was reported in most studies in which old age (age > 50 years) has been found to be a significant risk factor for difficult laparoscopic cholecystectomy & a higher conversion rate had been reported in old age group patients as in studies done by Lee et al. (2012),[31] & Hussain (2011).[32] While in Gupta et al. (2013),[5] study, it is found that old age was not a significant factor (P value = 0.065) & the authors have explained that by probability of their long surgical experience.

Postoperative specimens of gall bladder in males have showed a higher rate of inflammatory changes due to several causes; First, males delay seeking medical care and are more careless about their health.[33] Second, men with symptomatic gall bladder are more prone to inflammation and fibrosis with the same disease intensity thus leading to difficulty in dissection as is reflected in our study. They discovered high levels of collagen, hydroxyproline, mast cells, macrophages, and eosinophils in the wall of gallbladder and pericholecystic tissue, which may help to explain why men are more likely to develop fibrotic tissues.[34] It was proposed that estrogen may limit the activation of macrophages or prevent their aggregation in the wound, suppressing the formation of adhesions.[35]

In the current study, 269 male patients had difficult operation & converted to open representing 70.1% of the male patients (384), while only 209 (21.5%) of female patients had difficult lap choles. There was significant difference regarding the patient sex (P value < 0.05). This corresponds to what was mentioned in the study of Nidoni et al. (2015).[1] In which male sex was found to be a risk factor for conversion (p value = 0.034). However, few studies e.g., Fried et al. (1994),[36] Teixeira et al. (2000),[37] & others have shown that male sex was an independent risk factor. Also, a study by Liu et

al. (1996),[38] did not notice sex to be associated with conversion.

While a patient's ASA grade is a measure of their overall health and fitness, it was independently correlated to an increasing difficulty in performing a cholecystectomy and was therefore included in Nassar scoring scale. Even though the ASA score is somewhat subjective and has a moderate inter-rater reliability, it is widely accepted as a reliable indicator of patients' pre-operative health. other studies have detected that the pre-operative ASA score has also associated with a number of unfavorable outcomes following cholecystectomy, including gangrenous gallbladder disease, conversion from laparoscopic to open procedure, worst post-operative complications, and requirement for post-operative interventions e.g., ERCP & interventional radiology drainage, along with the duration of hospital stay, readmission, and postoperative mortality.[8]

In this current study, it was found that 11 of 18 patients with preoperative ASA score 4-5 had difficult lap choles representing 61.1%. However, only 24.1% of patients with ASA score 1 had converted to open. Also, it was found that preoperative ASA score was independent factor in our study. This contrasted with what was reported in the study by Nassar et al., (2020),[8] in which The ASA score and surgical difficulty are significantly correlated with rates of difficult operations for grades 1, 2, 3, and 4-5 being 22%, 32%, 46%, and 73%, respectively.

Acute cholecystitis is considered as one of the most frequent reasons for conversion of laparoscopic cholecystectomy to open.[7]

If detected in its earliest stages, acute cholecystitis can be treated very easily via surgical resection with low morbidity and mortality. On the other hand, if progression of the disease occurred, it might be associated with considerable morbidity and mortality. Therefore, it is crucial to define disease severity to precisely understand and improve outcomes associated to various disease severity stages. Criteria for the precise diagnosis of acute cholecystitis have been extensively discussed and reevaluated periodically.[39]

Defining the status of the gallbladder at surgery and the degree of any cholecystitis will facilitate more standardized reporting and improve pathways and management of risk-adjusted outcomes.[7]

Since Carl Langenbuch reported the first open cholecystectomy in 1882 and Muhe the first laparoscopic cholecystectomy in 1985, recently there has been increasing attention to grading severity of cholecystitis.[40]

Tokyo Guidelines (TG) are a proven methodology to assign severity in acute cholecystitis, the stepwise approach to securing a definitive diagnosis using patient physiologic parameters and symptoms.[41] **(Table 7).**

For emergency general surgery (EGS), the American Association for the Surgery of Trauma (AAST) suggested a clinical, radiological, surgical, and pathological grading system to provide a standardized and anatomically based framework for risk adjustment and comparison of various centers results.[39] **(Table 8) (Figure 3).**

Also, other cholecystitis severity scores, such as the 10-point intra-operative gallbladder grading system (G10), were suggested. four main factors determine the G10 cholecystitis severity score: operative appearance of the gall bladder; whether distended or contracted, accessibility, the existence of peritoneal cavity sepsis; either biliary or purulent peritonitis, and/or a cholecysto-enteric fistula **(Table 9).** cholecystectomy was considered easy if the G10 score was less than 2, moderate if it was from 2 to 4 and difficult if it was from 5 to 7 and extreme if it was from 8 to 10.[7]

Moreover, increased levels of LFT and amylase in serum indicate ongoing hepatitis, cholangitis, and pancreatitis. This may predispose to difficulty in dissection due to oedema.[30]

Some authors concluded that serum C-reactive protein (CRP) level or procalcitonin level reflect local inflammation and are useful in predicting DLC.[43] Other studies predicted DLC by assessing local inflammation using CT imaging or abdominal ultrasound examination.[44]

Advances in MRI technology have made it possible to measure the apparent diffusion coefficient (ADC) by using diffusion-weighted whole-body imaging with background body signal suppression (DWIBS) for images of the abdominal region. Recently, studies assessing the intensity of local inflammation by ADC have also been reported. If the ADC value reflects local inflammation of the gallbladder and cystic duct, the difficulty of surgery can be predicted by referring to the measured ADC value.[2]

New grading and scoring systems have also been reported in a variety of publications. Some of these scoring systems are based on imaging and preoperative clinical manifestations, however they only focus on actual operative results, which restricts their applicability. Recent validation of the AAST scoring system has led to suggestions that it is preferable to the 2013 Tokyo classification **(Table 1),** in part because the AAST scoring system includes more grades of acute cholecystitis **(Table 2).** The three grades used by the Tokyo guidelines for acute cholecystitis classification do not substantially include the intraoperative findings. The potential scoring-grading system has recently

been expanded by the Tokyo updates, but this has not yet been validated.[7]

However, most of these studies are difficult to use in daily practice because of their complexity and use of a lot of factors. Additionally, many of these scoring systems can't be used preoperatively.[1]

In this current study, 58.5% of patients who were admitted as acute cholecystitis had difficult operations unlike those who admitted with acute pancreatitis, biliary colic & CBD stone cases that had lower percentages of difficult lap choles (28.5%, 25.3% & 27.1% respectively). Also, it was noted the procedure in all six cases who admitted for lap chole for GB polyp was accomplished laparoscopically & was easier than other diagnosis. A significant difference was found between the primary diagnosis & the difficulty of the procedure (P value < 0.05).

This corresponds to what was published in most studies e.g., a study by Stanisic et al. (2020),[22] in which 72.7% of patients admitted with acute cholecystitis had difficult lap choles with a P-value < 0.01.

The gallbladder wall's thickness makes it difficult to be grasped, manipulated, and separated from its bed, making the procedure difficult. A gallbladder wall thickness over 3 mm was suggested by some studies such as Carbotta et al. (2018),[44] study while others like Gupta et al. (2013),[5] scored the gall bladder wall when greater than 4 mm.[8]

In our study, 457 (38.4%) patients with thick GB wall (≥3 mm) have difficult procedures & a significant difference was found (P value = 0.027). This is like what was reported in a study by Nidoni et al. (2015).[1] in which Gall bladder wall thickness > 3mm has been identified as a risk factor for conversion with the mean gall bladder wall thickness in easy, difficult and conversion group was 3, 3.6, 5.6 respectively. This also corresponds to what was reported in Stanisic et al. (2020)[22] study in which DLC was more frequent in cases with ultrasonographically verified GB wall thickness > 4 mm (P value < 0.05) and GB wall fibrosis (P value < 0.05) regardless of the difference between our study & Stanisic et al. (2020),[22] study in the critical GB wall thickness.

Also, in a study by Singh & Ohri (2006),[45] they found significant association of gall bladder grasping difficulty with distended gall bladder and pericholecystic inflammation. Moreover, in the study by Vivek et al. (2014),[30] it was found that contracted, distended gall bladder or gall bladder filled with stones were significantly related to difficult grasping of the gall bladder during lap chole due to its tendency to be slipped away. Also, inflammation around the gall bladder causes the wall to become edematous and friable, making it difficult to be grasped.

The CBD diameter was scored as a predictor of difficult laparoscopic cholecystectomy by many studies as in this current study, Siddiqui et al. (2017),[3] Vivek et al. (2014),[30] and Nassar et al. (2020)8 when it was > 6 mm. However, Carmody et al. (1994),[46] reported that pre-operative evaluation by ultrasound is of little value in screening for difficult cases. In our study, 235 (40.8%) patients of those had CBD dilation >6 mm had converted to open.

In cases of difficult LC, the degree of transient focal enhancement of the liver close to the gallbladder during the arterial phase of dynamic CT increased considerably, according to preoperative abdominal CT imaging **(Figure 4),** and if CT attenuation ratio of the arterial phase (ARAP) is ≥ 1.55, it can predict a difficult LC in three-phasic dynamic CT findings. In addition, the three-phasic dynamic CT is helpful for predicting difficult LC for acute cholecystitis if symptoms and laboratory results also suggest acute cholecystitis.[47]

In this current study, 204 (82%) cases of those underwent preoperative CT abdomen had difficult lap choles as most of them was proved to have acute complicated cholecystitis by the CT as expected by routine US abdomen. There was significant association found between difficult lap choles & preoperative CT abdomen (P value < 0.05).

This corresponds to what was mentioned in Nassar et al. (2020),[8] study, in which 45% of patients who underwent preoperative CT abdomen had difficult lap choles that were converted to open in the CholeS cohort study, while 69.8% of those in the single surgeon series (Reference study) with preoperative CT abdomen had difficult operations. Also, significant difference was reported in preoperative CT abdomen in both cohort studies (P value < 0.001). On the other hand, Maehira et al (2017),[47] study found no correlation between difficult LC and CT findings, but this conclusion may have been affected by the study's smaller sample size.

Regarding to preoperative MRCP, correspondence was detected between our study & Nassar et al. (2020),[8] study. In our study, 40.5% of cases who underwent preoperative MRCP had difficult procedures with a significant difference detected (P value = 0.032). In Nassar et al. (2020),[8] study, 35.5% of patients with preoperative MRCP had difficult lap choles in the CholeS cohort study, while 57.3% of patients' operations were converted to open in single surgeon series (Reference study) with preoperative MRCP. Also, significant difference was reported in preoperative MRCP in both cohort studies (P value < 0.001).

In patients who had preoperative ERCP, the gallbladder during surgery might be inflamed, non-visualized with difficult dissection of the

Calot's triangle and duct clipping, presence of pericholecystic adhesions or anatomical ductal variations. Therefore, patients who required preoperative ERCP had a higher chance of having a difficult cholecystectomy.[30]

This was against what was detected in this current study in which no significant difference was found in preoperative ERCP (P value = 0.94). it was found that 35.1% of cases who underwent preoperative ERCP with/without stenting had difficult procedures that were converted open. While in Ishizaki et al. (2006),[48] study, they found post ERCP status to be a significant predictor of difficulty in Calot's triangle dissection and adhesolysis.

Various studies considered conversion the procedure to open and prolonged operating times as indicators of difficulty of laparoscopic cholecystectomy. However, a decision to convert a procedure to open and the duration of the procedure might differ significantly depending on the operator's skills and expertise. Moreover, there are other considerations that may prolong the duration of the procedure or convert to open such as access or equipment failure and dealing with intraoperative complications e.g., bowel or vascular injury. These examples stand apart from any factors of difficulty directly related to the gallbladder or the structures around it.[8]

In the current study, the mean operative time was 94.3 min (Range 37-343). This was 74.6 min (37-213) for elective and 104.7 min (41-343) for emergency cases respectively. While in the study by Sugrue et al. (2019),[7] the mean operative time was 78.7 minute with a range of 15–400. It was 71.8 min (15–400) & 87.3 min (24– 278) for elective and emergency cases respectively. There was statistically significant difference in both studies (P value < 0.001).

Pericholecystic adhesions between the gall bladder and the omentum and/or colon are one type of intraoperative intraabdominal adhesions. This is caused by previous attacks of cholecystitis that can induce an inflammatory response & sometimes the adhesions may only affect a small portion of the gall bladder, or they may cover the entire gall bladder.[17]

In this current study, 60.3% of patients with history of previous admission for calcular GB disease had difficult lap choles. There was no significant difference detected regarding history of previous attacks (P value = 0.11).

This corresponds to what was reported in the study of Jameel et al. (2020),[17] in which more than half of the cases (53.9%) had no previous history of admission due to gall stones, while 20.9% & 25.2% of patients had history of previous admission with biliary colic & acute cholecystitis respectively. So, association with gall bladder adhesions was not significant (P value = 0.123) as most patients in their study had no adhesions with the gall bladder.

However, in Nassar et al. (2020),[8] & Agrawal et al., (2015)[49] studies, there was statistically significant differences detected regarding history of previous attacks of calcular GB problems (P value < 0.001 & < 0.05 respectively).

Some patients with a clinical diagnosis of acute cholecystitis may have delayed laparoscopic cholecystectomy due to variations in logistical problems and various hospital policies in the management of gallstone disease. Studies that included patients who had prior hospital admissions due to gallstone disease provide strong support to this. According to Bourgouin et al. (2016),[21] cholecystectomy difficulty is mostly expected by the presence of clinical acute cholecystitis. However, they found that the best indicator of surgical difficulties was the time interval between the onset of symptoms and surgery. According to the latest NICE guidelines for the management of cholecystitis, it has been proposed that doing laparoscopic cholecystectomy within the first week of diagnosis may limit difficult and complex surgery.[8]

In this current study, the percentages of difficult procedures in patients who were admitted either elective, delayed or emergent to OR were 26.8%, 34.4% & 36.5% respectively. There was significant difference between the type of admission & difficulty of surgery (P value < 0.05). This corresponds to what was mentioned in Nassar et al. (2020),[8] & Ashfaq et al. (2016),[50] studies that urgent admission was found to be a significant independent predictor factor.

Also, in our study, 44% of patients who admitted as emergent and admitted to OR at the 3rd day or more, had difficult lap choles. In the study of Liu et al. (1996),[38] the conversion rate (9.1%) was significantly lower for emergency LC performed within 3 days after presentation with acute cholecystitis.

In the footsteps of Lirici et al. (2010),[55] study before, this current study used the Nassar scale as an objective assessment of difficulty to optimize the intra-operative management of complicated gallstone patient.

Nassar difficulty score based on classification of difficulty which was used and analyzed in a large multicenter prospective CholeS research study. The CholeS study cohort included over 8000 operations has been carried out by many surgeons with various experience levels, in contrast to the dataset used for external validation, which was based on the practice of a single surgeon who was specialized in biliary surgery and had operated more than 4000 lap choles over 20 years.[8]

Finally at this current study, the patients & percentages of difficult operations were classified according to the preoperative risk score from 0 to 19 & then, subdividing all risk scores into 3 subgroups: low, medium & high-risk score, it was found that 297 (56%) of preoperative high-risk patients (7-19) had difficult operations, while 166 (24.4%) of medium-risk patients (2-6) had difficult operations. Only fifteen (10.1%) patients of the Low-risk group had difficult procedures. While, In Nassar et al. (2020),[8] study, the proportion of difficult operations was 11% (78/712) in low risk, 31.1% (626/2012) in medium risk and 80.0% (493/616) in high-risk patients.

Conclusions

There is a real need for a preoperative scoring system that can accurately predict difficult & challenging laparoscopic cholecystectomy cases to assist in selection of patients as a day case surgery, proper timing & OR team, to assign the procedure to a surgeon with the appropriate experience and to counsel the patient throughout the consent process.

Nassar difficulty grading scale is considered straightforward, clinically & surgically applicable, and easy to use preoperative scoring system that can be used to achieve the previous goals.

References

1. Nidoni R, Udachan TV, Sasnur P, Baloorkar R, Sindgikar V, Narasangi B: Predicting difficult laparoscopic cholecystectomy based on clinicoradiological assessment. ***J Clin Diagn Res.*** 2015; 9(12): 9-12.

2. Kurata Y, Hayano K, Ichinose M, Sasaki T, Kainuma S, Fukasawa K, et al: Preoperative prediction of difficult laparoscopic cholecystectomy based on diffusion-weighted magnetic resonance imaging. ***Asian J Endosc Surg.*** 2021; 14(3): 520-528.

3. Siddiqui MA, Rizvi SAA, Sartaj S, Ahmad I, Rizvi SWA: A standardized ultrasound scoring system for preoperative prediction of difficult laparoscopic cholecystectomy. ***J Med Ultrasound.*** 2017; 25(4): 227-231.

4. Laws HL: The difficult cholecystectomy: problems during dissection and extraction. ***Semin Laparosc Surg.*** 1998; 5(2): 81-91.

5. Gupta N, Ranjan G, Arora MP, Goswami B, Chaudhary P, Kapur A, Kumar R, Chand T: Validation of a scoring system to predict difficult laparoscopic cholecystectomy. ***Int J Surg.*** 2013; 11(9): 1002-1006.

6. Panni RZ, Strasberg SM: Preoperative predictors of conversion as indicators of local inflammation in acute cholecystitis: Strategies for future studies to develop quantitative predictors. ***J Hepatobiliary Pancreat Sci.*** 2018; 25(1): 101-108.

7. Sugrue M, Coccolini F, Bucholc M, Johnston A, Negoi I, Litvin A, et al: Intra-operative gallbladder scoring predicts conversion of laparoscopic to open cholecystectomy: A WSES prospective collaborative study. ***World J Emerg Surg*** 2019; 14: 12.

8. Nassar AHM, Hodson J, Ng HJ, Vohra RS, Katbeh T, Zino S, et al: Predicting the difficult laparoscopic cholecystectomy: Development and validation of a pre-operative risk score using an objective operative difficulty grading system. ***Surg Endosc.*** 2020; 34(10): 4549-4561.

9. Nassar A, Ashkar K, Mohamed A, Hafz A: Is laparoscopic cholecystectomy possible without video technology? ***Minim Invasive Ther.*** 1995; 4(2): 63–65.

10. Griffiths EA, Hodson J, Vohra RS, Marriott P, Katbeh T, Zino S, et al: Utilisation of an operative difficulty grading scale for laparoscopic cholecystectomy. ***Surg Endosc.*** 2019; 33(1): 110-121.

11. Ramírez-Giraldo C, Alvarado-Valenzuela K, Isaza-Restrepo A, Navarro-Alean J: Predicting the difficult laparoscopic cholecystectomy based on a preoperative scale. ***Updates Surg.*** 2022; 74(3): 969-977.

12. Doyle DJ, Hendrix JM, Garmon EH: American Society of Anesthesiologists Classification. 2022 Dec 4. In: StatPearls [Internet]. Treasure Island (FL): StatPearls Publishing; 2022 Jan. Available from https://www.ncbi.nlm.nih.gov/books/NBK441940/; PMID: 28722969.

13. Sathesh-Kumar T, Saklani AP, Vinayagam R, Blackett RL: Spilled gall stones during laparoscopic cholecystectomy: A review of the literature. ***Postgrad Med J.*** 2004; 80(940): 77-79.

14. Southern Surgeons Club: A prospective analysis of 1518 laparoscopic cholecystectomies. ***N Engl J Med.*** 1991; 324(16): 1073-1078.

15. Bhandari TR, Khan SA, Jha JL: Prediction of difficult laparoscopic cholecystectomy: An observational study. ***Ann Med Surg (Lond).*** 2021; 72: 103060.

16. Lujan JA, Parrilla P, Robles R, Marin P, Torralba JA, Garcia-Ayllon J: Laparoscopic cholecystectomy vs open cholecystectomy in the treatment of acute cholecystitis: A prospective study. ***Arch Surg.*** 1998; 133(2): 173-175.

17. Jameel SM, Bahaddin MM, Mohammed AA: Grading operative findings at laparoscopic cholecystectomy following the new scoring system in Duhok governorate: Cross sectional study. ***Ann Med Surg (Lond).*** 2020; 60: 266-270.

18. Hadad SM, Vaidya JS, Baker L, Koh HC, Heron TP, Hussain K, et al: Delay from symptom onset increases the conversion rate in laparoscopic cholecystectomy for acute cholecystitis. ***World J Surg.*** 2007; 31(6): 1298-1303.

19. Sutcliffe RP, Hollyman M, Hodson J, Bonney G, Vohra RS, Griffiths EA: Preoperative risk factors for conversion from laparoscopic to open cholecystectomy: A validated risk score derived from a prospective U.K. database of 8820 patients. ***HPB (Oxford).*** 2016; 18(11): 922-928.

20. Veerank N, Togale MD: Validation of a scoring system to predict difficult laparoscopic cholecystectomy: a one-year cross-sectional study. ***J West Afr Coll Surg.*** 2018; 8(1): 23-39.

21. Bourgouin S, Mancini J, Monchal T, Calvary R, Bordes J, Balandraud P: How to predict difficult laparoscopic cholecystectomy? Proposal for a simple preoperative scoring system. ***Am J Surg.*** 2016; 212(5): 873-881.

22. Stanisic V, Milicevic M, Kocev N, Stanisic B: A prospective cohort study for prediction of difficult laparoscopic cholecystectomy. ***Ann Med Surg (Lond).*** 2020; 60: 728-733.

23. Kama NA, Kologlu M, Doganay M, Reis E, Atli M, Dolapci M: A risk score for conversion from laparoscopic to open cholecystectomy. ***Am J Surg.*** 2001; 181(6): 520-525.

24. Nassar AHM, Zanati HE, Ng HJ, Khan KS, Wood C: Open conversion in laparoscopic cholecystectomy and bile duct exploration: Subspecialisation safely reduces the conversion rates. ***Surg Endosc.*** 2022; 36(1): 550-558.

25. Sakuramoto S, Sato S, Okuri T, Sato K, Hiki Y, Kakita A: Preoperative evaluation to predict technical difficulties of laparoscopic cholecystectomy on the basis of histological inflammation findings on resected gallbladder. ***Am J Surg.*** 2000; 179(2): 114-121.

26. Kanakala V, Borowski DW, Pellen MG, Dronamraju SS, Woodcock SA, Seymour K, et al: Risk factors in laparoscopic cholecystectomy: A multivariate analysis. ***Int J Surg.*** 2011; 9(4): 318-323.

27. Rosen M, Brody F, Ponsky J: Predictive factors for conversion of laparoscopic cholecystectomy. ***Am J Surg.*** 2002; 184(3): 254-258.

28. Randhawa JS, Pujahari AK: Preoperative prediction of difficult lap chole: A scoring method. ***Indian J Surg.*** 2009; 71(4): 198-201.

29. 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 (KUMJ).*** 2007; 5(1): 8-11. PMID: 18603978.

30. Vivek MA, Augustine AJ, Rao R: A comprehensive predictive scoring method for difficult laparoscopic cholecystectomy. ***J Minim Access Surg.*** 2014; 10(2): 62-67.

31. Lee NW, Collins J, Britt R, Britt LD: Evaluation of Preoperative Risk Factors for Converting Laparoscopic to Open Cholecystectomy. ***The American Surgeon.*** 2012; 78(8): 831-833.

32. Hussain A: Difficult laparoscopic cholecystectomy: Current evidence and strategies of management. ***Surg Laparosc Endosc Percutan Tech.*** 2011; 21(4): 211-217.

33. Akcakaya A, Okan I, Bas G, Sahin G, Sahin M: Does the difficulty of laparoscopic cholecystectomy differ between genders? ***Indian J Surg.*** 2015; 77(Suppl 2): 452-456.

34. Yol S, Kartal A, Vatansev C, Aksoy F, Toy H: Sex as a factor in conversion from laparoscopic cholecystectomy to open surgery. ***JSLS.*** 2006; 10(3): 359-363.

35. Kartal A, Aksoy F, Vatansev C, Sahin M, Yilmaz O, Belviranli M, et al: Does estrogen cause low conversion rates in laparoscopic cholecystectomies for acute and chronic cholecystitis in women? ***JSLS.*** 2001; 5(4): 309-312.

36. Fried GM, Barkun JS, Sigman HH, Joseph L, Clas D, Garzon J, et al: Factors determining conversion to laparotomy in patients undergoing laparoscopic cholecystectomy. ***Am J Surg.*** 1994; 167(1): 35-41.

37. Teixeira JP, Saraiva AC, Cabral AC, Barros H, Reis JR, Teixeira A: Conversion factors in laparoscopic cholecystectomy for acute cholecystitis. ***Hepatogastroenterology.*** 2000; 47(33): 626-630. PMID: 10919000.

38. Liu CL, Fan ST, Lai EC, Lo CM, Chu KM: Factors affecting conversion of laparoscopic cholecystectomy to open surgery. ***Arch Surg.*** 1996; 131(1): 98-101.

39. Hernandez M, Murphy B, Aho JM, Haddad NN, Saleem H, Zeb M, et al: Validation of the AAST EGS acute cholecystitis grade and comparison with the Tokyo guidelines. ***Surgery.*** 2018; 163(4): 739-746.

40. Sugrue M, Sahebally SM, Ansaloni L, Zielinski MD: Grading operative findings at laparoscopic cholecystectomy- a new scoring system. ***World J Emerg Surg.*** 2015; 10: 14.

41. Tominaga GT, Staudenmayer KL, Shafi S, Schuster KM, Savage SA, Ross S, et al: American Association for the Surgery of Trauma Committee on Patient Assessment. The American Association for the Surgery of Trauma grading scale for 16 emergency general surgery conditions: Disease-specific criteria characterizing anatomic severity grading. ***J Trauma Acute Care Surg.*** 2016; 81(3): 593-602.

42. World Society of Emergency Surgery Trials Registry: G10-Trial.2016. Available on-line at https://www.wses.org.uk/trials.

43. Wennmacker SZ, Bhimani N, van Dijk AH, Hugh TJ, de Reuver PR: Predicting operative difficulty of laparoscopic cholecystectomy in patients with acute biliary presentations. ***ANZ J Surg.*** 2019; 89(11): 1451-1456.

44. Carbotta G, Panebianco A, Laforgia R, Pascazio B, Balducci G, Bianchi FP, et al: A new clinical-ultrasound score to predict difficult videolaparocholecystectomies: A prospective study. ***Ann Med Surg (Lond).*** 2018; 35: 59-63.

45. Singh K, Ohri A: Difficult laparoscopic cholecystectomy: A large series from north India. ***Indian J Surg.*** 2006; 68: 205-208.

46. Carmody E, Arenson AM, Hanna S: Failed or difficult laparoscopic cholecystectomy: Can preoperative ultrasonography identify potential problems? ***J Clin Ultrasound.*** 1994; 22(6): 391-396.

47. Maehira H, Kawasaki M, Itoh A, Ogawa M, Mizumura N, Toyoda S, et al: Prediction of difficult laparoscopic cholecystectomy for acute cholecystitis. ***J Surg Res.*** 2017; 216: 143-148.

48. Ishizaki Y, Miwa K, Yoshimoto J, Sugo H, Kawasaki S: Conversion of elective laparoscopic to open cholecystectomy between 1993 and 2004. ***Br J Surg.*** 2006; 93(8): 987-991.

49. Agrawal N, Singh S, Khichy S: Preoperative prediction of difficult laparoscopic cholecystectomy: A scoring method. ***Niger J Surg.*** 2015; 21(2): 130-133.

50. Ashfaq A, Ahmadieh K, Shah AA, Chapital AB, Harold KL, Johnson DJ: The difficult gall bladder: Outcomes following laparoscopic cholecystectomy and the need for open conversion. ***Am J Surg.*** 2016; 212(6): 1261-1264.

51. Lirici MM, Califano AD: Management of complicated gallstones: Results of an alternative approach to difficult cholecystectomies. ***Minim Invasive Ther Allied Technol.*** 2010; 19(5): 304-315.