

A Study of Pre-Operative Predictors of Difficult Laparoscopic Cholecystectomy

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Abstract: *This study was aimed to assess various pre-operative predictors (history/ clinical/ imaging) and develop a scoring method for difficult laparoscopic Cholecystectomy and to correlate preoperative predictive factors with intraoperative difficulty in lap Cholecystectomy. Laparoscopic Cholecystectomy (LC) has become the procedure of choice for management of symptomatic gall stone disease. The following conclusions can be drawn from the study; Surgeons encounter difficulty when there were dense adhesions in the Calot's triangle, fibrotic and contracted GB, acutely inflamed, gangrenous gall bladder and cholecystoenteric fistula etc. There are many risk factors which make laparoscopic surgery difficult like old age, male sex, attacks of acute Cholecystitis and pancreatitis, obesity, previous abdominal surgery, palpable gall bladder and certain ultrasonographic findings i.e. thickened gall bladder wall, distended gall bladder, pericholecystic fluid collection, impacted stone etc. Six parameters namely male sex, age >60 years and preoperative diagnosis of acute Cholecystitis were found to have significant effect on risk of conversion on statistical analysis. Preoperative prediction of the risk of conversion or difficulty of operation is an important aspect of planning laparoscopic surgery, future studies should focus on studying the difference when different surgeons operate and how far the grading system is reliable between them baseline being a standard experience in laparoscopic surgery.*

Keywords: Difficult Laparoscopic Cholecystectomy, Cholelithiasis, Laparoscopic Cholecystectomy, Pre-Operative Predictors

1. Introduction

Cholecystectomy was considered the surgical procedure for gall stone disease (Cholelithiasis) in 1882, when its pioneer Carl Johann August Langenbuch, performed the first Cholecystectomy in a patient who suffered from Cholelithiasis. Laparoscopic Cholecystectomy (LC) is considered the gold standard treatment for most of the gallbladder diseases. The advantages of LC are earlier return of bowel function, less post-operative pain, cosmetic, shorter duration of hospital stay and also earlier return to full activity. At times LC has become difficult. It takes longer duration even with bile/stone spillage and occasionally it requires conversion to open Cholecystectomy (OC). It is very difficult to predict preoperatively, whether it is going to be easy or difficult. The degree of difficulties in LC is again impossible to predict. At present there is no standard scoring system available to predict the degree of difficulty preoperatively. In this study, we have worked out a scoring system for predicting the difficulty in LC preoperatively and correlate with our intraoperative degree of difficulty. The study identifies the factors that can predict difficulty in LC and thus complications can be prevented beforehand.

2. Objectives

- The study was aimed to assess various preoperative predictors {history/ clinical/ imaging} and develop a scoring method for difficult laparoscopic Cholecystectomy.
- To correlate preoperative predictive factors with intraoperative difficulty in laparoscopic Cholecystectomy.

3. Review of Literature

The laparoscopic approach has become the standard for the cholecystectomy; it reproduces the open Cholecystectomy technique with the neck-toward-fundus approach as described later. With the patient in a supine position, general endotracheal anesthesia is induced, preoperative antibiotics are administered, and bilateral lower extremity sequential compression devices are placed. The abdomen is widely prepped and draped in the usual sterile fashion. In general, the abdomen is accessed with an open-technique Hasson port placement at the umbilicus and the pneumoperitoneum established. Alternatively, a Veress needle could be used to access the abdominal cavity. The intraperitoneal placement of the needle is confirmed with a saline drop test. Using the Veress technique, the Veress needle is exchanged for a 5-mm port and the pneumoperitoneum is initiated. A laparoscope is introduced through the Hasson port or the 5-mm port used for access, and diagnostic laparoscopy is used to confirm there was no injury to intraabdominal contents during the access placement. Under direct vision, three additional 5-mm ports are introduced in the abdominal cavity, two in the right upper quadrant and right flank and one port in the subxiphoid region. If the Veress technique was used and a 5-mm port placed at the umbilicus, a 10-mm port is placed in the subxiphoid region along with the other two lateral ports. The patient is then positioned with the head up and left side down, and attention is given to the right upper quadrant. With one of the lateral ports, a gallbladder grasper is used to retract the fundus cephalad above the liver by the assistant surgeon. Another grasper may be used to retract the infundibulum of the gallbladder and lateral and anterior traction is applied to straighten the cystic duct away from the common bile duct. The operation commences with an incision to the peritoneal undersurface of the gallbladder with the hook electrocautery and extends to the anterior aspect of the hepatoduodenal ligament. Too much traction may cause tenting of the common bile duct,

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which can lead the surgeon to misidentify it as the junction of the common bile duct and the cystic duct. Blunt dissection of the triangle is performed to identify the cystic duct and its junction with the gallbladder and the common bile duct. A grasper can be used to palpate the duct and identify stones and milk them back up into the gallbladder as performed in the open surgery. At this point, an intraoperative cholangiogram may be performed if there is suspicion for a common bile duct stone. The common bile duct may be opened and explored if a stone is palpable or detected on cholangiogram. The cystic duct and the cystic artery are dissected in the Calot triangle. Next, the "critical view of safety" technique is performed. This technique requires three elements: the triangle of Calot must be dissected free of fat (without exposing the common bile duct), the base of the gallbladder must be dissected off the liver bed (or cystic plate), two structures (and only two, the cystic duct and artery) enter the gallbladder and these can be seen circumferentially (360-degree view). This creates two windows, one between the cystic duct and the artery and the other between the artery and the liver bed. Once this technique is completed, the cystic structures are safely divided. When exposing these windows, enough of the gallbladder should be taken off the liver bed (similar to the technique used in open cholecystectomy on the fundus-down approach and more in acute cholecystitis), so that it is obvious that the only remaining step is the division of the structures. Once the anatomy is fully recognized, the cystic duct is clipped and transected as close to the gallbladder as feasible to prevent injury to the common bile duct. The length of the cystic duct stump, once thought to be related to postcholecystectomy syndrome, is not critical. It is far more important not to injure the common bile duct. Once the cystic artery has been isolated and distinguished from a right hepatic artery, it is sharply divided between clips and transected. Once the cystic artery and cystic duct have been divided, the neck of the gallbladder should be free and dissecting the gallbladder from its hepatic fossa begins. Continuous upward traction on the neck of the gallbladder facilitates exposure of the investing peritoneum around the gallbladder and the alveolar tissue between the gallbladder and the liver. The gallbladder is freed from its fossa by a combination of electrocautery and blunt dissection. This continues all the way up to the fundus until the gallbladder is free. Occasionally, there may be aberrant bile duct branches from the right hepatic or common hepatic ducts communicating directly with the cystic fossa, the so-called ducts of Luschka. These may be clipped and divided. In case of a postoperative bile leak, these ducts often cease draining spontaneously. The gallbladder bed and cystic artery are inspected for hemostasis. There have been valuable lessons learned from complications of laparoscopic cholecystectomy, such as developing techniques to minimize these complications.

One potential fatal complication is the injury of the common bile duct. This usually happens because of anatomy misidentification, such as when the common bile duct is mistaken for the cystic duct. The "critical view of safety" technique described previously, published by Strasberg in 1995 has been used to minimize biliary injuries in the era of laparoscopy and has become a very important safety maneuver.

4. Materials and Methods

Place: Department of General Surgery, Stanley Medical College Hospital

Design: Prospective Non Randomized Study

Period: October 2016 to August 2017

Sample Size: 41

Inclusion Criteria: The patients aged between 16 and 60 yrs presenting with symptoms and signs of Cholelithiasis / Cholecystitis and diagnosed by USG examination in dept of general surgery, Stanley medical college

Exclusion Criteria:

- Patients below 15 years of age.
- Patients with CBD calculus, dilated CBD, where CBD exploration was needed.
- Patients with features of obstructive jaundice.
- Patients not willing for laparoscopic Cholecystectomy.

Method of Data Collection

The patients confirmed by USG examination will be evaluated with following factors

History:

Age, Sex, h/o previous hospitalization (abdominal surgeries/ Cholecystitis/ pancreatitis)

Clinical:

BMI, Abdominal scar whether infraumbilical or supraumbilical, palpable gall bladder

Imaging:

Gall bladder wall thickness, pericholecystic collection, impacted stone.

Age	<50 (0)	>50 (1)	Score
Sex	Female (0)	Male (1)	
H/O Hospitalization	No (0)	Yes (4)	
BMI	<25 (0)	>25-27.5 (1), >27.5 (2)	
Abdominal Scar	No (0)	Infraumbilical (1), Supraumbilical (2)	
Palpable GB	No (0)	Yes (1)	
GB Wall Thickness	Thin (<4mm) (0)	ThiK (>4mm) (2)	
Pericholecystic Collection	No (0)	Yes (1)	
Impacted Stone	No (0)	Yes (1)	

Total Score:

Grading: Easy (<5) / Difficult (6-10) / Very Difficult (11-15)

Following evaluation the patient will be subjected to LC

- Operative Time taken from incision to port closure
- Biliary / stone spillage
- Bleeding during surgery
- Injury to duct / artery
- Need for conversion regarding upon the difficulty of the case

Easy:

- Time taken <60 min
- No bile spillage
- No injury to duct, artery

Difficult:

- Time taken 60–120 min
- Bile/stone spillage
- Injury to duct
- No conversion

Very difficult

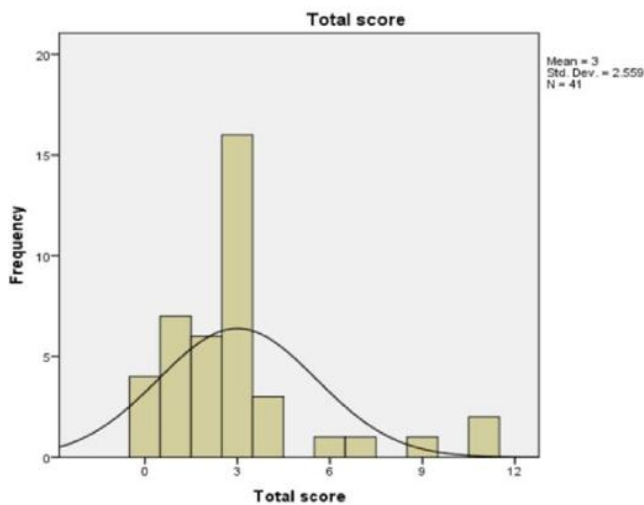
- Time taken >120 min
- Conversion

5. Results

Grading of total score

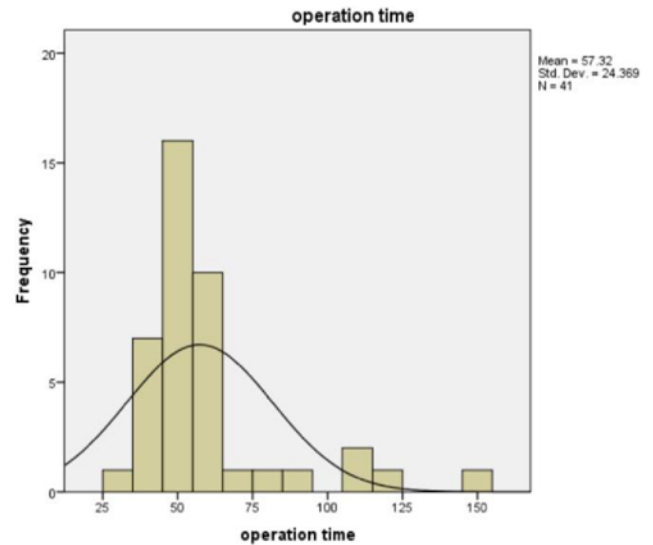
Only 3 patients (7.3%) had a grading of difficult compared to 2 patients (4.9%) who had very difficult scoring. The following table and figure shows the total score grading among the sample.

Total Score Grade	Frequency	Percentage
Easy	36	87.8
Difficult	3	7.3
Very Difficult	2	4.9



Grading of operation time

Only 5 patients (12.2%) had a grading of difficult compared to 2 patients (4.9%) who had very difficult scoring. The following figure and table shows the grading of operation time.



Operation Time in Minutes Grade	Frequency	Percentage
Easy	34	82.9
Difficult	5	12.2
Very Difficult	2	4.9

Correlation between operation time grading and grading of total score

Majority of the time (n=39, 95.1%) there was a correlation between the operation time grading and grading of total score.

Chi-square test for independence

Chi-square test for independence between the operation time grading and grading of total score shows a very significant value at $p < 0.001$ and a Pearson Chi-Square value of 64.233 with degrees of freedom=4. The following table shows the test results.

Chi-Square Tests for independence

	Value	df	Asymp. Sig. (2-sided)
Person Chi-square	64.233 ^a	4	.000
Likelihood Ratio	30.405	4	.000
N of Valid Cases	41		

Correlation tests between various variables

Variables	r	P (Significant at 0.05 level)	Significant/Not Significant
Age and total score	0.147	0.007	Significant
Age and total duration of surgery	0.287	0.069	Not Significant
Sex and total score	-0.120	0.454	Not Significant
Sex and total duration of operation	0.043	0.791	Not Significant
Operation time and total score	0.896	0.001	Significant
Operation time and BMI score	-0.251	0.118	Not Significant
Total Score and BMI score	-0.097	0.55	Not Significant
Total Score and Abdominal Scar	0.59	0.001	Significant
Operation time and Abdominal Scar	0.558	0.001	Significant
Total Score and GB wall thickness	0.845	0.001	Significant
Operation time and GB wall	0.873	0.001	Significant

thickness			
Total Score and pericholecystic Collection	0.855	0.001	Significant
Operation time and pericholecystic Collection	0.862	0.001	Significant
Total Score and History of hospitalization	0.813	0.001	Significant
Operation time and History of hospitalization	0.771	0.001	Significant

There is a significant positive correlation between age and total score of the participants ($r=0.417$, $p<0.05$), very high significant positive correlation between operation time and total score ($r=0.896$, $p<0.001$), positive significant relationship between total score and abdominal scar ($r=0.590$, $p<0.001$), positive significant relationship between operation time and abdominal scar ($r=0.558$, $p<0.001$), positive significant relationship between total score and GB wall thickness ($r=0.845$, $p<0.001$), positive significant relationship between operation time and GB wall thickness ($r=0.873$, $p<0.001$), positive significant relationship between total score and Pericholecystic collection ($r=0.855$, $p<0.001$), positive significant relationship between operation time and Pericholecystic collection ($r=0.862$, $p<0.001$), positive significant relationship between total score and history of hospitalization ($r=0.813$, $p<0.001$), and positive significant relationship between operation time and history of hospitalization ($r=0.771$, $p<0.001$). Two cases did not fall into the correct prediction of outcome from scoring. One of them was a 65 year old male with a BMI of 23.80 with supraumbilical incision. It was predicted as easy with a score of 4 but the duration extended to 90 minutes making it difficult. Another case was a 66 year old male with a BMI of 23.44 with infraumbilical incision. It was predicted as easy with a score of 3 but the duration extended to 70 minutes making it difficult. This is attributed to the presence of adhesions inside the abdominal cavity.

6. Discussion

The gold standard treatment of choice for gallbladder disease mainly symptomatic cholelithiasis is laparoscopic cholecystectomy (Oymaci et al., 2014). But this treatment is not devoid of complications albeit it is lower in experienced hands which require caution from the surgeon (Jethwani et al., 2013). The present study was aimed to assess the various preoperative predictors (history/ clinical/ imaging) and develop a scoring method for difficult laparoscopic cholecystectomy with a secondary objective of correlating preoperative predictive factors with intraoperative difficulty in lap cholecystectomy. A study of 41 patients to understand the pre-operative predictors of difficult laparoscopic cholecystectomy revealed that a majority of them were above 50 years of age (58.5%, $n=24$) and most of them were females (63.4%, $n=26$). Chi-square test for independence between the operation time grading and grading of total score shows a very significant value at $p<0.001$ and a Pearson Chi-Square value of 64.233 with degrees of freedom=4. In our study, the method employed was to develop a scoring system to preoperatively ascertain the difficulty in laparoscopic cholecystectomy based on clinical findings, history and sonology. The grades were given as easy (<5), difficult (5-10) and very difficult (11-15). The

scoring system was able to predict correctly 39 times (95.1%) out of the 41 cases in consideration. Randhawa JS et al. in 2009 (88-92%, easy to difficult) and Dhanke PS et al. in 2014 (94.05-100%, easy to difficult) published similar findings. Only two cases did not correlate with the score due to previous surgeries that had left adhesions. Both the cases were males. Higher BMI, GB thickness >4mm, previous history of hospitalisation, female gender and pericholecystic collection are associated with difficult and very difficult grading of scores. This study is in agreement with Dhanke PS et al. in 2014 who reported that history of prior hospitalization; high BMI and pericholecystic collection are predictors of the difficulty of laparoscopic cholecystectomy. Nachnani J et al. in 2005 also reported that BMI >30 kg/m², previous history of hospitalisation and GB thickness >3mm are good predictors of the level of difficulty in laparoscopic cholecystectomy. In this study, only one case (2.45%) was converted into open due to frozen calots and omental adhesions. This is very different compared to 19 cases (17%) by Randhawa JS et al. in 2009, 27.9% (Oymaci et al, 2014), 11.4% (Nachnani J et al in 2005), 0.36% (Singh K et al, 2005), 5.3% (Ishizaki Y et al, 2006) and 5.7% (Bakos E et al, 2008). This variation can be accounted due to the difference in sample size, the underlying prognostic determinants of the individual, surgeon to surgeon variations and lack of uniform evaluating system. The low rate of complications can be attained by perfecting the surgical techniques along with the experience of the surgeons. In this study, there is a significant positive correlation between age and total score of the participants ($r=0.417$, $p<0.05$), very high significant positive correlation between operation time and total score ($r=0.896$, $p<0.001$), positive significant relationship between total score and abdominal scar ($r=0.590$, $p<0.001$), positive significant relationship between operation time and abdominal scar ($r=0.558$, $p<0.001$), positive significant relationship between total score and GB wall thickness ($r=0.845$, $p<0.001$), positive significant relationship between operation time and GB wall thickness ($r=0.873$, $p<0.001$), positive significant relationship between total score and Pericholecystic collection ($r=0.855$, $p<0.001$), positive significant relationship between operation time and Pericholecystic collection ($r=0.862$, $p<0.001$), positive significant relationship between total score and history of hospitalisation ($r=0.813$, $p<0.001$), and positive significant relationship between operation time and history of hospitalization ($r=0.771$, $p<0.001$). Owing to a small sample, the validation of the scoring system is limited. On the other hand, a single surgeon has been followed to avoid individual bias in surgery. An individual surgeon has been followed for the given duration and the results reflect the outcomes of surgery from a single surgeon. A balance has been maintained to get adequate sample size avoiding the bias from different surgeons.

Two cases did not fall into the correct prediction of outcome from scoring. One of them was a 65 year old male with a BMI of 23.80 with supraumbilical incision. It was predicted as easy with a score of 4 but the duration extended to 90 minutes making it difficult. Another case was a 66 year old male with a BMI of 23.44 with infraumbilical incision. It was predicted as easy with a score of 3 but the duration extended to 70 minutes making it difficult. This is attributed to the presence of adhesions inside the abdominal cavity.

The current scoring system used in this study is very effective in predicting the difficulty of the laparoscopic cholecystectomy with very high sensitivity. The smaller sample size limits the ability to accurately predict and discuss the other determinants of difficulty in laparoscopic cholecystectomy. Future research should focus on finding out the exact relationship between the individual variables and the difficulty of the surgical procedure.

7. Conclusion

This study was aimed to assess various pre-operative predictors (history/ clinical/ imaging) and develop a scoring method for difficult laparoscopic Cholecystectomy and to correlate preoperative predictive factors with intraoperative difficulty in lap Cholecystectomy. Laparoscopic Cholecystectomy (LC) has become the procedure of choice for management of symptomatic gall stone disease. The following conclusions can be drawn from the study; Surgeons encounter difficulty when there were dense adhesions in the Calot's triangle, fibrotic and contracted GB, acutely inflamed, gangrenous gall bladder and cholecystoenteric fistula etc. There are many risk factors which make laparoscopic surgery difficult like old age, male sex, attacks of acute Cholecystitis and pancreatitis, obesity, previous abdominal surgery, palpable gall bladder and certain ultrasonographic findings i.e. thickened gall bladder wall, distended gall bladder, pericholecystic fluid collection, impacted stone etc. Six parameters namely male sex, up, previous episode of Cholecystitis, previous upper abdominal surgery, sonographically ascertained thick gallbladder wall, age >60 years and preoperative diagnosis of acute Cholecystitis were found to have significant effect on risk of conversion on statistical analysis. Preoperative prediction of the risk of conversion or difficulty of operation is an important aspect of planning laparoscopic surgery, future studies should focus on studying the difference when different surgeons operate and how far the grading system is reliable between them baseline being a standard experience in laparoscopic surgery.

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