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A clinical study to determine predictive factors for difficult laparoscopic cholecystectomy

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Abstract
The technique of laparoscopic cholecystectomy (LC) has been standardized and it has become a routine and safe operation. However, there are numerous conditions which make the operation difficult necessitating conversion to open surgery. Preoperative prediction of a difficult cholecystectomy and the risk of conversion is of great help both to the patient who can be counseled appropriately pre-operatively and the surgeon who can also schedule his time and team accordingly. This prospective cross-sectional study was conducted on 118 patients undergoing laparoscopic cholecystectomy in Department of General Surgery, Aditya Birla Memorial Hospital, Chinchwad, Pune, over a period of 18 months from October 2015 to March 2017, to evaluate and correlate the clinical, biochemical and ultrasonography findings with the operative findings for anticipating difficult laparoscopic cholecystectomy. The parameters which were studied are age ≥ 60 years, sex, BMI > 30, history of (h/o) previous upper abdominal surgery, history of gall stone related complications, history of prior biliary intervention, biochemical parameters like Hb, TLC and LFT levels, gall bladder wall thickness (≥ 4 mm), pericholecystic collection, gall bladder size (contracted or distended gall bladder), stone impaction at neck/cystic duct and stone size > 1 cm. The operative parameters taken to assess the difficulty of the LC were total time taken to operate from the insertion of the trocar to the extraction of the gall bladder (more than 90 minutes), change of procedure to subtotal cholecystectomy and conversion to OC. Our study results show that significant predictors for difficult LC are increasing age of patients, h/o gall stone related complications, h/o prior biliary intervention, raised TLC and deranged LFT levels, GB wall thickness ≥ 4 mm, pericholecystic fluid collection, tensely distended/contracted GB and stone size > 1cm. However factors like sex of patient, BMI, history of previous upper abdominal surgery, haemoglobin levels and stone impacted at neck of gall bladder showed no significant relation with operative difficulty.

Keywords: A clinical study surgery laparoscopic cholecystectomy

Introduction
Mouret[1] introduced laparoscopic cholecystectomy (LC) in 1987. It rapidly replaced open cholecystectomy (OC) as the standard treatment. In 1992, The National Institute of Health consensus development conference stated that LC "provides a safe and effective treatment for most patients with symptomatic gall stones."
Advantages of LC include reduced hospitalization, decreased morbidity, short recovery time and better cosmesis. However, compared with OC, the incidence of injuries to the bile duct seems to be increased [2, 3].
LC though safe and effective, is time consuming and can be difficult. Various problems faced are difficulty in creating pneumoperitoneum, accessing peritoneal cavity, releasing adhesions, discerning anatomy and extracting the gall bladder.
The definition of difficult LC is inconsistent. The term difficult cholecystectomy refers to multiple technical intra-operative difficulties that increase the risk for complications and significantly prolong the operating time. Approximately 2% to 15% of patients require conversion to open surgery for various reasons [4, 5]. Therefore, it is essential to study the predictive factors for difficult LC. Hence, we have undertaken this study of predictive factors for difficult LC. Ability to predict a difficult LC would allow the surgeon to discuss the likelihood of conversion with the patient and counsel him/her appropriately pre-operatively regarding post-operative recovery. Other benefits would be to allow more efficient scheduling of the operating lists and ensuring the availability of a more experienced laparoscopic surgeon for the anticipated difficult operation.

AIM

To identify the predictors for difficult laparoscopic cholecystecotmy.

Methodology

118 patients underwent laparoscopic cholecystectomy who met the inclusion criteria (Inclusion criteria: All patients with symptomatic gall stone disease admitted for LC. Exclusion criteria: Patients with known carcinoma gall bladder, LC combined with other surgeries, Instrument failure, Pregnant patient) were enrolled. After obtaining informed consent, patients were evaluated with following parameters: age, sex, body mass index (BMI), history of previous surgery, gall stone related complications, prior biliary intervention, palpable gall bladder, biochemical parameters and sonographic findings. After evaluating the patients, they were followed up in the operating room. Difficulties encountered in performing the process of laparoscopic cholecystectomy were noted.

The operative parameters taken to assess the difficulty of the LC were total time taken to operate from the insertion of the trocar to the extraction of the gall bladder (more than 90 minutes),[6] and change of procedure to subtotal cholecystectomy and conversion to OC.

Result & Discussion

Age and sex distribution of the patients

On stratifying by age, maximum number of cases (n = 47; 39.8%) were seen between the age group of 31-40 years, 24 (20.3%) patients were above 60 years of age, 19 (16.1%) patients were between age group of 41-50 years, 17 (14.4%) patients were below 30 years of age, and 11 (9.3%) patients were between age group of 51-60 years. In our study, 65.3% (n=77) of the patients were females while males constituted 34.7% (n=41) of all patients. This finding is in accordance with the fact that the prevalence of gall stones is much higher in females, as compared to males. The higher prevalence in females has mainly been attributed to female sex hormones, estrogen and progesterone, which adversely influence hepatic bile secretion, its composition and storage. Estrogens, while increasing the cholesterol secretion, also diminish bile salt secretion; conversely progestins act in a complementary fashion, by also reducing bile salt secretion and additionally impairing gall bladder emptying [7].

Correlation of operative difficulty with different parameters

1. Age and gender

On correlating the operative difficulty by age, 6 out of 19 cases in the age group of 41-50 were found to be difficult, 3 out of 11 cases were difficult in age group of 51-60 and 8 out of 24 cases were found to be difficult in age > 60 years. Hence we can say that statistically there is significant relation (p value = <0.0001) between increase in difficulty level with increase in age of patients. of the many factors cited in the literature, age is considered one of the significant factors for a difficult LC. Reasons postulated include a long duration of disease and subsequent thickening and more contracted GB wall. In such cases the cystic duct becomes foreshortened and GB may be adherent to common bile duct [8]. Increasing age is associated with an increased probability of multiple attacks of cholecystitis and also increased frequency of upper abdominal surgeries. Therefore, there is increased incidence of fibrosis and adhesions in the hepatic hilum causing difficulty for the surgeon [9]. Our analysis showed that 18/118 (15.3%) patients had difficult LC.

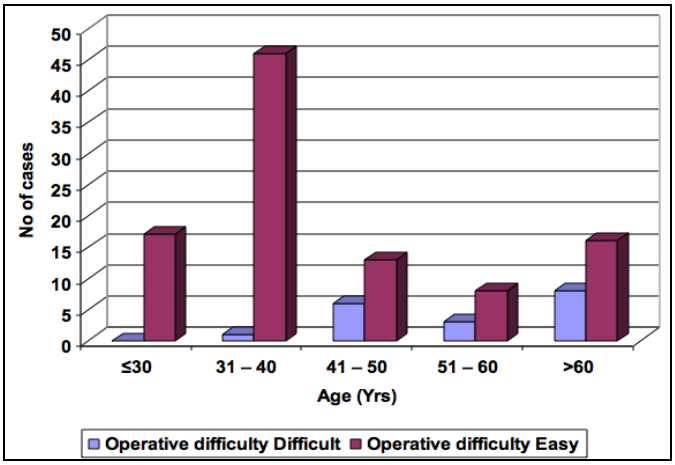

Fig 1: Bar diagram showing association between age and operative difficulty in study group

The operative difficulty on correlating with gender, though, did not reveal a statistically significant difference in our study, there still was a noticeable difference between the two groups. While only 12.99% (10 of 77) females faced a difficulty during surgery, the percentage was much higher in the male sex group. Of the total of 41 men included in the study, one-fifth (n=8, 19.5%) met with an operative difficulty, coinciding with the findings in the literature, that male sex is an independent risk factor for a difficult LC. It has been postulated that this unique difference between genders is due to the fact that males tend to have a higher threshold for pain, and hence seek medical attention later than their female counterparts. Relating to the same, it has been hypothesized that males may have a series of undiagnosed subacute inflammations, before the index presentation[10] thereby making the adhesions more dense, the anatomy more distorted and the surgery more difficult.

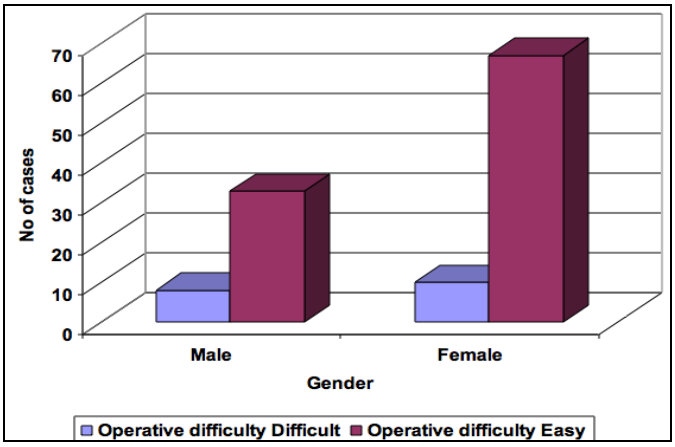

Fig 2: Bar diagram showing association between gender and operative difficulty in study group

2. BMI: 6/25 (24%) patients with BMI > 30 had difficult LC and 12/93 (12.9%) patients with BMI < 30 had difficult LC. There was no statistical significant relation of difficulty level with BMI > 30 in our study (P = 0.21), as compared to other studies which shows difficulty level increases with increase in BMI [11, 12, 13]. Obesity is known to make access to the peritoneal cavity difficult and obesity is associated with fatty liver and Calot‟s triangle adhesions, thus necessitating conversion to open laparotomy.[12] However, Simopoulos *et al.* declared that LC is effective and safe in patients with morbid obesity.[14]

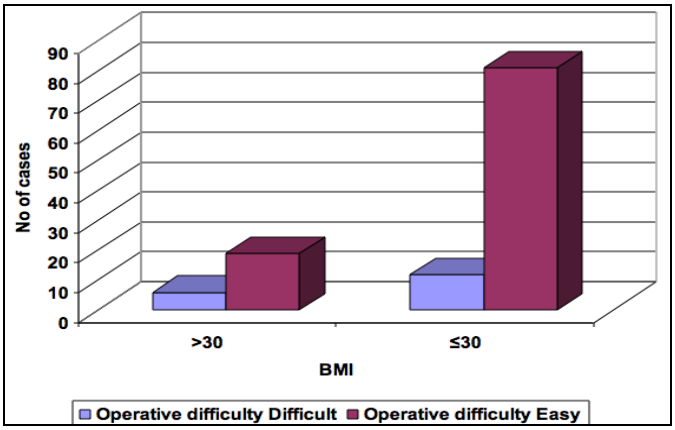

Fig 3: Bar diagram showing association between BMI and operative difficulty in study group

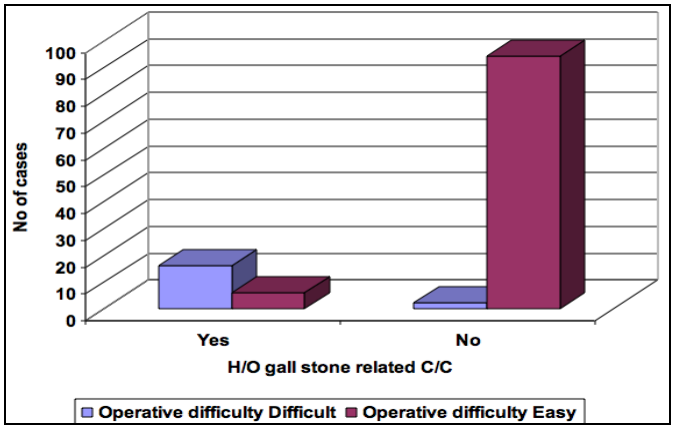

Fig 4: Bar diagram showing association between H/O gall stone related C/C and operative difficulty in study group

3. History of Gall stone related complications: 16/22 (72.7%) patients with gall stone related complications had difficult LC. Gall stone related complications include previous biliary colic attacks, acute cholecystitis and pancreatitis.

There is significant relation (*P*<0.0001) between difficulty level and history of gall stone related complications. Prior acute cholecystitis or acute pancreatitis results in a scarred and fibrosed gall bladder, and in dense fibrotic adhesions that render laparoscopic dissection difficult [8, 11, 12, 16].

4. History of previous upper abdominal surgery: In our study of 118 patients, only 1 had previous upper abdominal operation and he had a difficult LC. Patients with previous upper abdominal surgery may have presence of gross adhesions and the laparoscopic procedure may fail. Previous abdominal surgery poses problems during creation of pneumoperitoneum and during adhesiolysis to gain adequate exposure to the operative field [8, 9, 12, 14]. Previous upper abdominal surgery is not a contraindication to laparoscopic surgery, but the patient should be warned of increased risk of bowel injury and the greater chance of conversion.

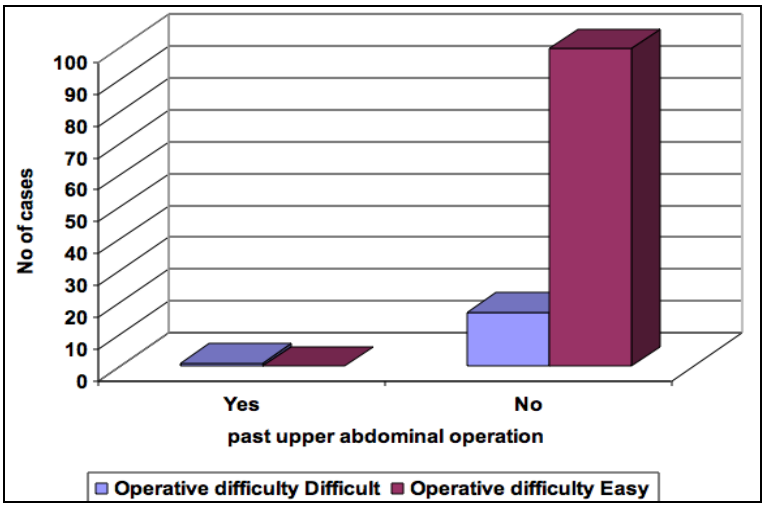

Fig 5: Bar diagram showing association between past upper abdominal operation and operative difficulty in study group

5. History of prior biliary intervention: All 3 patients with h/o ERCP had difficult LC. There is significant relation (P = 0.003) between difficult LC and h/o prior biliary intervention. Due to common bile duct stone repeated contractions of GB occurs which results in inflammation and adhesions around GB. Due to poor exposure it makes the procedure difficult [9, 17, 18]. Ishizaki Y *et al.* [19] in their study have found post ERCP status to be a significant predictor of difficulty in adhesiolysis and Calot‟s triangle dissection.

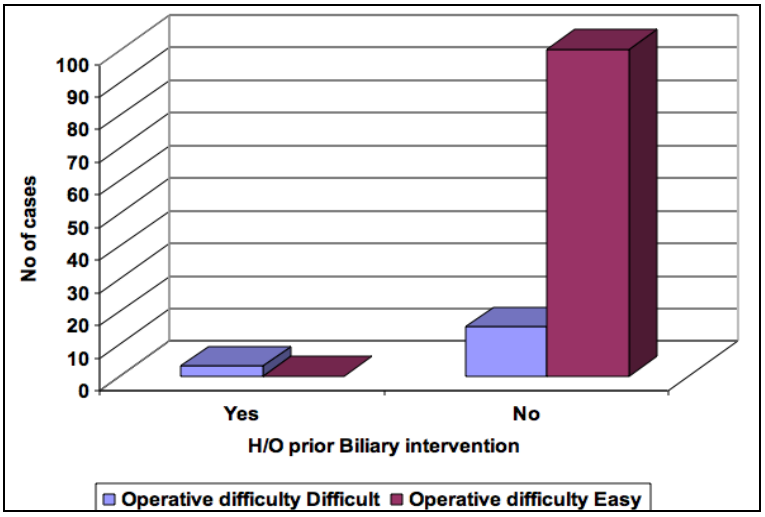

Fig 6: Bar diagram showing association between h/o prior biliary intervention and operative difficulty in study group

6. Biochemical Parameters

Amongst the biochemical parameters (Hb, TLC, LFT) taken in this study, raised TLC count and deranged LFT were found to be significant preoperative predictor for difficult LC. This can be probably attributed to persisting acute inflammation with edema of the gall bladder making surgery difficult. Moreover, patients with raised counts in cases of acute cholecystitis are likely to have a complicated gall bladder [20, 21]. Abnormal LFT and elevated amylase signify ongoing hepatitis, cholangitis and pancreatitis that pose difficulty in dissection due to edema [9, 17, 20].

7. Ultrasound findings

A transabdominal ultrasound performed in 118 patients, showed a thickened gall bladder wall in 39 of 118 patients (33%) patients, while a calculus larger than 1 cm was found in 17 of the 118 patients (14.4%). Pericholecystic fluid was found in 13.6% patients, calculus impacted at neck was found in 6.8% patients. 40.7% patients had tensely distended or contracted gall bladder. The findings on ultrasound collaborated well with the findings intra-operatively, which is in accordance with what is reported in literature, including an article by Casey B. Duncan and colleagues [22].

Correlation of preoperative ultrasound parameters with the net operative difficulty

A. GB wall thickness: 17/39 (43.6%) patients with GB wall > 4 mm had difficult LC and 1/79 (0.013%) patients with GB wall < 4 mm had difficult LC. GB wall thickness is related to the inflammation or fibrosis that follows previous attacks of cholecystitis,and thus may reflect difficulty in delineation of the anatomy during surgery [12].

Thickened wall makes it difficult for the surgeon to achieve a firm grasp on the organ. The weak grip results in inadequate traction of the organ, leading to a poorly exposed hepatobiliary triangle and hence a higher risk of inadvertent injuries. A poorly exposed Calot‟s triangle directly violates the basic principles of adequate exposure, thereby making it difficult to delineate the anatomical structures and precluding complete skeletonization of both the cystic duct and the cystic artery. This increases the possibility of injuries, while at the same time making the surgery last longer, both resulting in a potentially complicated and difficult surgery [12, 14, 15, 17, 19], Hutchinson CH *et al.*, Liu CL *et al.* and Kama NA *et al.* considered gall bladder thickness to be the most important sonographic risk factor of conversion to OC [23, 24, 25].

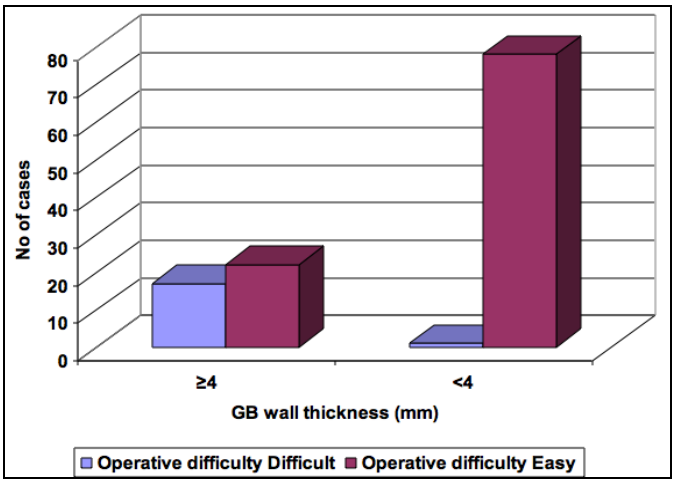

Fig 7: Bar diagram showing association between GB wall thickness and operative difficulty in study group

B. Stone size > 1 cm: Concomitantly, a large calculus, measuring more than 1 cm in size had a positive, statistically significant (P< 0.005), correlation with the operative difficulty in 7 of our patients. Large calculi tend to cause repeated gall bladder mucosal irritation, resulting in frequent attacks of cholecystitis, and hence repeated inflammation and fibrosis. This so-called „frozen Calot‟s triangle‟ results in operative difficulty during dissection and in identification of cystic duct and artery. This poor delineation of structures during the procedure results in a higher likelihood of injury to the biliary tree, and to the hepatic vessels. It also results in a much longer time taken for dissection and delineation, thereby making the surgery challenging, prolonged and potentially difficult. A stone larger than 1 cm in size, apart from causing difficulty during dissection, also causes difficulty during extraction of gall bladder. The calculus being larger than the port size results in challenges during extraction, wherein the stone needs to be broken before retrieval. The process of breaking the hard calculus sometimes causes „instrumental ‟rupture of gall bladder wall, causing spillage of bile around the port site, and into the peritoneal cavity. The process to retrieve the spilled calculi and to thoroughly lavage the abdominal cavity, is another time consuming process that tends to make the surgery difficult and lengthy. The port site spillage also causes a higher incidence of port site infections and eventual port site herniation. U Jethwani and colleagues, in the year 2013, reported similar findings in

their study, wherein they found that a calculus larger than 1cm was an independent risk factor for a difficulty LC.[14] Saber AA *et al*. reported stone >1cm size to be a predictor of difficult LC [26].

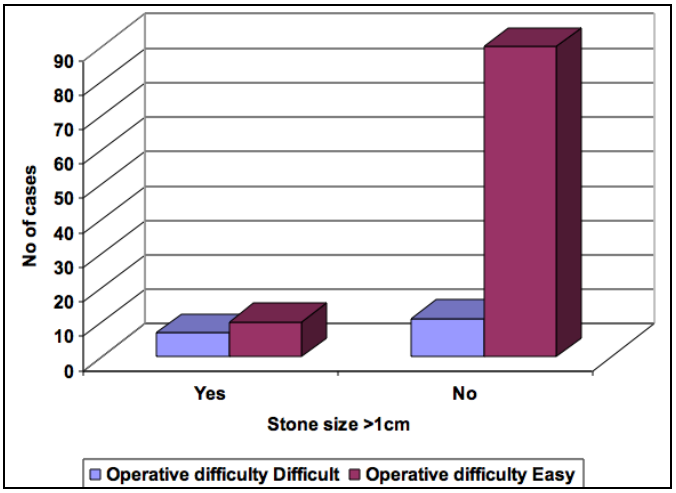

Fig 8: Bar diagram showing association between stone size and operative difficulty in study group

C. Gall bladder size: There is a significant relation between gall bladder size and operative difficulty level (P=0.015 by combining distended + contracted vs normal). A contracted GB follows a series of multiple attacks of inflammation and subsequent adhesions in the region of Calot‟s triangle. For this reason a contracted GB has been quoted to be potential risk factor for higher conversion rates [6]. In distended gall bladder it is difficult to catch hold of the fundus of GB and hence aspiration of the contents of GB is often required. It is cumbersome, time consuming and also there is chance of spillage of contents into the peritoneal cavity [16]. A distended gall bladder or a gall bladder filled with stones is not easily grasped because it tends to slip away. Presence of inflammation around the gall bladder makes the wall friable and edematous, thus posing problems to grasping [9]. Singh K *et al*. in their study have also found significant association of gall bladder grasping difficulty with distended gall bladder and pericholecystic inflammation [27].

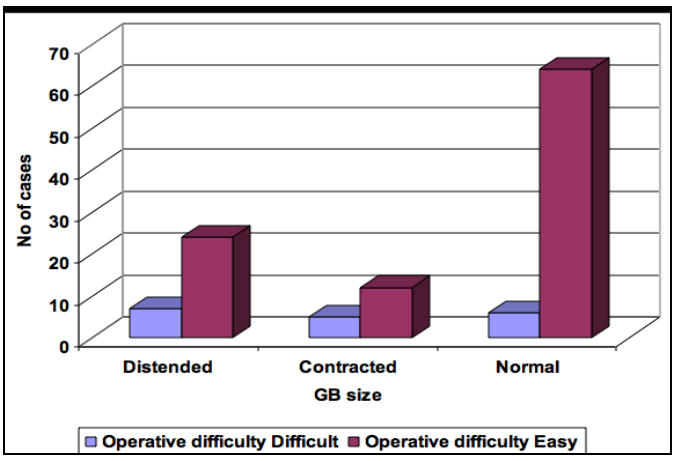

Fig 9: Bar diagram showing association between GB size and operative difficulty in study group

D. Pericholecystic fluid collection: Arumugam R *et al*. 49 found that patients with pericholecystic collection had difficult access to peritoneal cavity. We also found pericholecystic fluid collection (*P*<0.0001) to be a significant predictive factor for difficult LC in our study. In our study, the data, on analysis, revealed that a few sonographic parameters were predictive for a difficult LC. Of the five parameters analyzed, gall bladder wall thickness more than 4mm (*P*<0.0001), pericholecystic fluid collection (*P*<0.0001), stone size >1 cm (*P*<0.005) and variation in gall bladder size were found to be statistically significant. Calculus impaction at neck showed no statistically significant correlation with the operative difficulty. Most studies reviewed, have found statistically significant correlation with gall bladder wall thickness [12, 14], and a large intraluminal calculus [14].

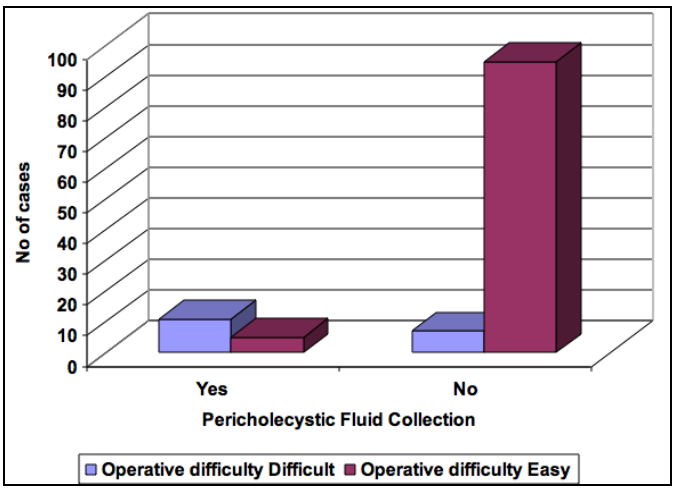

Fig 10: Bar diagram showing association between Pericholecystic Fluid Collection and operative difficulty in study group

Conversion Rate

3 out of 118 patients got converted to OC with conversion rate of 2.54%.

All 3 patients had h/o gall stone related complications and pericholecystic fluid collection. Two patients had h/o prior biliary intervention and thick gall bladder wall. The risk of conversion to OC is related to surgeon factors, patient factors and, possibly, equipment factors.

The reason for conversion in our study was inability to delineate the anatomy. Two factors, namely, past history of acute cholecystitis or acute pancreatitis and thickened gall bladder wall, were associated with difficulty in defining the anatomy. Prior acute cholecystitis or acute pancreatitis results in a scarred and fibrosed gall bladder and in dense fibrotic adhesions that render laparoscopic dissection difficult.

Gall bladder wall thickness is related to the inflammation or fibrosis that follows previous attacks of cholecystitis, and thus may reflect difficulty in delineation of the anatomy during surgery [12].

The various preoperative parameters in literature for predicting conversion to OC are obesity, raised LFT and raised TLC, h/o prior biliary intervention, h/o acute cholecystitis, h/o previous upper abdominal surgery, thick wall gall bladder, contracted gall bladder, pericholecystic fluid collection, stone size > 2cm [8, 17, 19].

It should be remembered that conversion should not be regarded as a complication or a failure, but as a prudent choice to avoid additional risks/damage in particular cases.

Common reasons for conversion such as bleeding, accidental lesions of the biliary ducts or adjacent organs and intolerance to pneumoperitoneum are difficult to predict preoperatively and may arise even in the simplest of laparoscopic cholecystectomies [15].

In such situations, there should not be any hesitation to call for

expert opinion, and a conversion should be considered prudent choice.

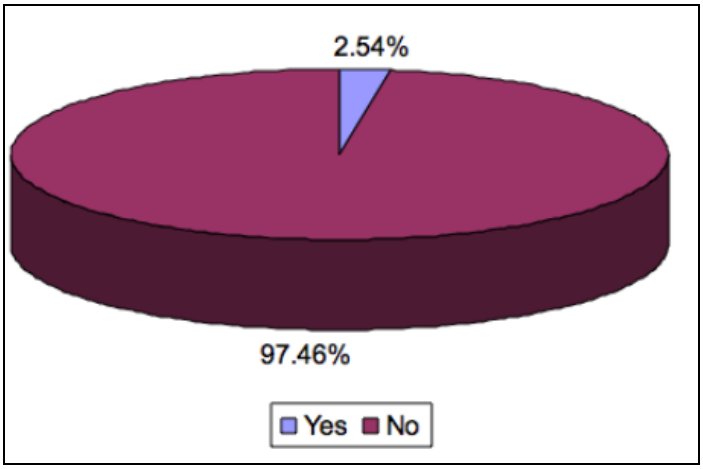

Fig 11: Pie diagram showing conversion to open wise distribution of cases in study group

Conclusion

Our study conclusively demonstrates that predictors for difficult laparoscopic cholecystectomy are:

1. Increasing age of patients
2. History of gall stone related complications like acute cholecystitis, biliary pancreatitis, choledocholithiasis.
3. History of prior biliary intervention like ERCP.
4. Raised TLC
5. Deranged LFT levels
6. GB wall thickness ≥ 4 mm
7. Pericholecystic fluid collection
8. Tensely distended or contracted GB
9. Stone size > 1cm

We recommend that these factors should be included in pre-operative investigative work-up of all patients posted for LC to improve patient outcome.

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