Document heading doi: 10.21276/apjhs.2019.6.2.4 **Research Article**

Assessment of risk factors for difficult surgery in laparoscopic cholecystectomy: An observational study

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Abstract

Background: Laparoscopic cholecystectomy has become the gold standard for the treatment of gallstones. The objective of our study was to identify the preoperative predictors of conversion of laparoscopic cholecystectomy into open cholecystectomy. **Methods & Subjects:** We carried out a cross-sectional study of 110 patients admitted to the Department of GI and Minimal Access Surgery, Fortis Hospital, Kolkata, West Bengal, India, from January 2019 to March 2019. All patients undergoing laparoscopic cholecystectomy were included in the study. Informed consent was obtained from all the participants. A structured questionnaire was used to collect the demographic data including age, sex, body mass index (BMI), comorbidities, and previous history of gallstones along with preoperative and operative findings from each patient. **Results:** A total of 110 patients were included in this study; the majority of them were females [74 (67.27%)]. In our study, the mean age was 46.72 years (SD: ±17.68 years). Majority of the patients 79 (71.82%) in the present study who was undergone through cholecystectomy, age less than 50 years. Regarding ultrasonography findings, 86 (78.18%) patients had multiple stone, whereas 23 (20.91%) patients had solitary stone. About 17 (15.45%) had impacted stone. Near about 29 (26.36%) patients had wall thickness greater than or equal to 4 mm. On preoperative evaluation, the number of cases predicted to be difficult/very difficult were 45 (40.91%) patients, and 21 (19.1%) of them were difficult/very difficult on surgery, whereas 24 (21.82%) patients turned out to be easy on surgery. **Conclusion:** The cases predicted to be easy on preoperative evaluation were 65 (59.09%) patients, of which 59 (53.64%) patients were actually easy, whereas 6 (5.45%) patients turned out to be difficult/very difficult on surgery. The rate of conversion of laparoscopic cholecystectomy to open cholecystectomy was found to be in nil patients. The decision to convert to open cholecystectomy is usually taken after a considerable time has been spent on trying to successfully perform the laparoscopic procedure. A significant delay in this decision can result in increased morbidity and mortality. Preoperative risk factors can help to predict difficult gallbladder and conversion to open cholecystectomy.

Keywords: Cholelithiasis, Acute cholecystitis, Cholecystectomy, Laparoscopy, Difficult Laparoscopic, Risk Factors

Introduction

Gallstone disease (GSD) represents a significant burden for health-care systems worldwide and is one of the most common disorders among patients presenting to emergency rooms with abdominal discomfort[1]. Gallstone disease may be thought of as having the following four stages:

1. The lithogenic state, in which conditions favor gallstone formation

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2. Asymptomatic gallstones
3. Symptomatic gallstones, characterized by episodes of biliary colic
4. Complicated cholelithiasis

Gallstones constitute a significant health problem in developed societies, affecting 10% to 15% of the adult population [2-4]. In India, the prevalence of gallstones ranges from 6% to 9% in the adult population[5, 6]. The general indications for laparoscopic cholecystectomy are the same as those for the corresponding open procedure. Although laparoscopic cholecystectomy was originally reserved for young and thin patients, it now is also offered to elderly and obese patients; in fact, these latter patients may benefit even more from surgery through small incisions. Biliary colic with sonographically identifiable stones is the most common indication for elective laparoscopic cholecystectomy[7].Acute cholecystitis, if diagnosed within 72 hours after symptom onset, can and usually should be treated laparoscopically. Beyond this 72-hour period, inflammatory changes in surrounding tissues are widely believed to render dissection planes more difficult. This may, in turn, increase the likelihood of conversion to an open procedure to 25%. Randomized control trials have not borne out this 72-hour cutoff and have shown no difference in morbidity. Other options include interval laparoscopic cholecystectomy after 4-6 weeks and percutaneous cholecystostomy. [8-10]

Important risk factors have been identified as being associated with gallstones[11]. Multiple case-control studies, comparing those with gallstones versus those without, have shown that gallstone formation is multifactorial. Some features, such as ethnicity, genetics, advancing age and female gender cannot be modified, whereas others (e.g., diet, physical activity, rapid weight loss and obesity) are modifiable[12]. A history of gallstones appears to carry the highest risk for gallbladder cancer, with a relative risk of 4.9. Most (69% to 100%) but not all people with gallbladder cancer have cholelithiasis[13]. The prevalence of gallbladder disease at any point in time (i.e., prevalence) has advanced with the use of ultrasonographic surveys as opposed to previous studies based on clinical or necropsy evidence. These population surveys have better defined important risk factors, both unchangeable and modifiable[14]. The rate of becoming symptomatic increased by 1% every year. Ever since its advent in 1985, laparoscopic cholecystectomy has established itself as a gold standard treatment option in terms of economy, better cosmetic results, and earlier return to work[15]. According to a nationwide study done in North America, approximately 75% of all cholecystectomy are performed laparoscopically[16].

Although considered a simple procedure, certain factors such as difficulty in creating pneumoperitoneum, dissecting triangle of Calot, and controlling hemorrhage from gallbladder bed can lead to unforeseen circumstances. These might include an increase in operation time, injury to vital structures, and conversion to open procedure[17].

The objective of our study was to identify the preoperative predictors of conversion of laparoscopic cholecystectomy into open cholecystectomy.

Methodology & subjects

We carried out a cross-sectional study of 110 patients admitted to the Department of GI and Minimal Access Surgery, Fortis Hospital, Kolkata, West Bengal, India, from January 2019 to March 2019. All patients undergoing laparoscopic cholecystectomy were included in the study [Table 1]. Ethical approval was taken from the concerned institutional committee for the commencement of the study. Informed consent was obtained from all the participants. A structured questionnaire was used to collect the demographic data including age, sex, body mass index (BMI), comorbidities, and previous history of gallstones along with preoperative and operative findings from each patient.

Diagnosis of symptomatic cholelithiasiswas made based on history, clinical examination, laboratory, and radiological investigations. The preoperative predictive factors of difficult LC (preoperative scoring system by Randhawa and Pujahari**)** included the following: (a) history: age, sex, and history of hospitalization for acute cholecystitis; (b) clinical data: BMI=weight (kg)/height (m2), abdominal scar, and palpable GB; and (c) sonographic data: wall thickness of GB, pericholecystic collection, and impacted stone, as shown in Tables 2. Grading of difficult level of LC as defined by Randhawa and PujaharI[18], as shown in Table 3 & 4.

Table 1: Inclusion and exclusion criteria

Inclusion Criteria	Exclusion Criteria
1. Symptomatic gallstone disease 2. Asymptomatic gallstone disease with following a. Size of calculus <3 mm or >3 cm b. Associated polyp c. Life expectancy >20 years d. Associated diabetes mellitus	1. Equipment or other technical failure, 2. Complicated cholelithiasis [pancreatitis, choledocholithiasis] 3. Co-morbidities other than hypertension or diabetes mellitus 4. Surgeon's experience of <30 cases/ 1 year 5. Reduced port surgeries 6. Contraindication to laparoscopic cholecystectomy

All patients underwent general anesthesia for the procedure after receiving a pre-induction dose of 1 g ceftriaxone intravenously. The decision to place a nasogastric catheter was taken peroperatively in only those cases where gastric distension affected the surgeon's view of the triangle of Calot. The surgical site was prepared and draped according to the standard protocols. Pneumoperitoneum was created by either close (80%) or open technique (20%).

Table 2: Scoring factors based upon history, clinical, and sonographic findings[18]

History			Max. score
Age	<50 yrs (0)	>50 yrs (1)	1
Sex	Female (0)	Male (1)	1
H/o Hospitalization	N (0)	Y (4)	4
Clinical			
BMI wt (kg)/ht. (mt^2)	<25 (0)	25–27.5 (1) > 27.5 (2)	2
Abdominal scar	N (0)	Infra umbilical (1) supra umbilical (2)	2
Palpable	N (0)	Y (1)	1
Sonography			
Wall thickness	Thin (0)	Thick > 4 mm (2)	2
Pericholecystic collection	N (0)	Y (1)	1
Impacted stone	N (0)	Y (1)	1
H/o = history of, N = No, Y = Yes, Total maximum score - 15			

The scores were compared in each patient to conclude whether preoperative predictive score was a useful method or not for prediction of intraoperative outcome. The operation was done by using CO_2 gas for pneumoperitoneum with 12 mmHg pressure. Four standard ports [two 10-mm and two 5-mm ports] were introduced in all cases. Cystic duct and artery were clipped in all laparoscopic cholecystectomies. The harmonic device was used for dissection in gallbladder bed and to achieve hemostasis. Those who got converted to open, Kocher's left subcostal incision was given and vinyl 2/0 was used to ligate cystic duct and achieve hemostasis. An 18 Fr drain was placed in subhepatic space in all the cases. All procedure details along with peroperative findings were filled in the questionnaire at the end of procedure. The patients who underwent laparoscopic cholecystectomy were discharged within first 48 h postoperatively, while those who underwent conversion were kept for 72-96 h for intravenous antibiotics and observation.

Table 3: Easy/difficult criteria for laparoscopic cholecystectomy as suggested by Randhawa and Pujahari[18]

Grading	Intraoperative parameters	Scores Grading
Easy	• Easy Time taken <60 min • no bile spillage • no injury to duct, artery	0-5
Difficult	• Time taken 60–120 min • bile/stone spillage • injury to duct • no conversion	6-10
Very difficult	• Time taken >120 min • conversion	11-15

Table 4: Preoperative prediction of difficulty levels according to scoring system

Scores	Difficulty level
0-5	Easy
6-10	Difficult
11-15	Very difficult

Quantitative data were represented as mean, SD, median, and range. Qualitative data were presented as number using Graph pad software. P value was considered significant if it was less than 0.05.

Results

We carried out a cross-sectional study of 110 patients admitted to the Department of GI and Minimal Access Surgery, Fortis Hospital, Kolkata, West Bengal, India, from January 2019 to March 2019.

Table 5: Patients characteristics and distribution of parameters [n=110]

Characteristics	Summary statistics [n (%)]
Age (years) [Mean±SD]	46.72±17.68
Age	
≤50	79 (71.82%)
>50	31 (28.18%)
Gender	
Male	36 (32.73%)
Female	74 (67.27%)
History of hospitalization for acute cholecystitis	
No	82 (74.55%)
Yes	28 (25.45%)
BMI, *n* (%)	
<25	69 (62.73%)
25.1-27.5	27 (24.55%)
>27.5	14 (12.73%)
Co-morbid diseases	48 (43.64%)
Previous surgical history, *n* (%)	
Tubectomy	11 (10%)
LSCS	9 (8.18%)
Appendectomy	5 (4.55%)
Hysterectomy	3 (2.73%)
Gallbladder palpable	9 (8.18%)
Ultrasonography findings, *n* (%)	
Multiple calculi	86 (78.18%)
Solitary calculi	23 (20.91%)
Acalculous	1 (0.91%)
Impacted stone	17 (15.45%)
Wall thickness	
Thin (<4mm)	81 (73.64%)
Thick (≥4mm)	29 (26.36%)
Total Leukocyte Count [per cumm, mean]*	
Overall, Male, Female	7698; 7489; 7742
Total Bilirubin [mg/dl, mean]	
Overall, Male, Female	0.94; 0.88; 0.98
Direct Bilirubin [mg/dl, mean]	
Overall, Male, Female	0.48; 0.38; 0.51
AST [U/l, mean]	
Overall, Male, Female	63.5; 68.3; 57.6
ALT [U/l, mean]	
Overall, Male, Female	59.8; 67.7; 51.83
ALP [U/l, mean]	
Overall, Male, Female	139.8; 149.6; 131.7

A total of 110 patients were included in this study; the majority of them were females [74 (67.27%)]. The patient characteristics are presented in Table 2. In our study, the mean age was 46.72 years (SD: ±17.68 years). Majority of the patients 79 (71.82%) in the present study who was undergone through cholecystectomy, age less than 50 years. Regarding ultrasonography findings, 86 (78.18%) patients had multiple stone, whereas 23 (20.91%) patients had solitary stone. About 17 (15.45%) had impacted stone. Near about 29 (26.36%) patients had wall thickness greater than or equal to 4 mm [Table 5]. Nine cases (8.18%) gallbladder was palpable on physical examination. Previous history of hospitalization with acute cholecystitis was reported in 28 (25.45%) cases [Figure 1]. BMI (>27.5) was reported 14 (12.73%) participants. Overall total billirubin, AST, ALT and ALP was noted 0.94 mg/dl, 63.5 IU/l, 59.8 IU/L and 139.8 IU/L. About 48 (43.64%) cases co-morbid conditions were reported.

Table 6: Indication for laparoscopic cholecystectomy

Indications for surgery	Male [%]	Female [%]	Total	P value
Acute cholecystitis	24 (21.82%)	56 (50.91%)	80 (72.73%)	P = 0.0038
Acalculous acute cholecystitis	1 (0.91%)	0	1 (0.91%)	-
Acute cholecystitis with biliary obstruction	8 (7.27%)	13 (11.82%)	21 (19.09%)	P = 0.4640
Interval cholecystectomy following an episode of acute cholecystitis	3 (2.73%)	5 (4.55%)	8 (7.27%)	P = 0.6473
Total	36 (32.73%)	74 (67.27%)	110 (100%)	P = 0.0007

Acute cholecystitis is the main reason for laparoscopic cholecystectomy in 80 (72.73%) followed by acute cholecystitis with biliary obstruction 21 (19.09%) and interval cholecystectomy following an episode of acute cholecystitis 8 (7.27%) [Table 6, Figure 2-5].

Table 7: Correlation between preoperative score and the outcome [n=110]

Preoperative scores	Easy	Difficult	Very difficult	Total
0-5	54	7	4	65
6-10	2	27	8	37
11-15	0	1	7	8
Total	56	35	19	110

On preoperative evaluation, the number of cases predicted to be difficult/very difficult were 45 (40.91%) patients, and 21 (19.1%) of them were difficult/very difficult on surgery, whereas 24 (21.82%) patients turned out to be easy on surgery. However, the cases predicted to be easy on preoperative evaluation were 65 (59.09%) patients, of which 59 (53.64%) patients were actually easy, whereas 6 (5.45%) patients turned out to be difficult/very difficult on surgery, as shown in Table 7, 9.

Table 8: Intraoperative findings – adhesions

Intraoperative adhesions	Male	Female	Total
Omental adhesions to			
1. Gallbladder	19	66	87 (79.1%)
2. Calot's triangle	5	16	21 (19.1%)
3. Anterior abdominal wall/falciform ligament	4	9	13 (11.82%)
Other adhesions between			
1. GB and anterior abdominal wall	5	2	7 (6.36%)
2. GB and bowel	9	6	17 (15.45%)
3. Bowel and Calot's triangle	0	3	3 (2.73%)
4. Liver and anterior abdominal wall or diaphragm	11	18	29 (26.36%)
5. Bowel and anterior abdominal wall	1	1	2 (1.82%)

During surgery, we found the gallbladder contracted in 9 [8.19%] patients. Omental adhesions to gallbladder 87 (79.1%) and Calot's triangle 21 (19.1%) were most co adhesions. The angle between cystic duct and common hepatic duct was narrow in 6 [5.45%] patients. Other adhesions between gallbladder and bowel 17 (15.45%) and liver and anterior abdominal wall or diaphragm 29 (26.36%) [Table 8, Figure 2-3].

Table 9: Comparison of preoperative evaluation with conversion to open procedure

	Number of cases converted to open procedure [n (%)]	Number of cases not required to be converted to open procedure [n (%)]	Total
Number of cases predict to be difficult/very difficult on preoperative evaluation	0	45 (40.91%)	45 (40.91%)
Number of cases predict to be easy on preoperative evaluation	0	65 (59.09%)	65 (59.09%)
Total	0	110 (100%)	110 (100%)

No patients were converted to open cholecystectomy from 45 (40.91%) patients found to be difficult/very difficult on preoperative evaluation. Moreover, no cases were converted to open from 65 (59.09%) patients found to be easy on preoperative evaluation, as shown in Table 9. Conversion rate was nil patients. Mean duration of surgery was 110.56 minutes.

Discussion

Morbid obesity is known to be associated with difficult surgery and increased risk for conversion[19,20]. In our study also showed females were more prevalent 74 (67.27%) for gall stones. Showed that females had higher incidence of gallstone disease with a ratio of 2.06:1, multiple gallstone was the predominant type 86 (78.18%), mean BMI (>27.5) of the study population was reported 14 (12.73%) participants. Women are twice as likely as men to form gallstones. Most common gallstone type found is mixed type and least is cholesterol type. Majority of the patients 79 (71.82%) in the present study who was undergone through cholecystectomy, age less than 50 years. Study had revealed that there is a statistically significant association between high BMI and occurrence of gallstone. There is a statistically significant association between diabetes and occurrence of gallstone[21]. In India, the prevalence of gallstones ranges from 6% to 9% in the adult population. Age, gender, ethnicity, diet, and sedentary lifestyle influence the prevalence of GSD[1].Many authors had suggested that the reason for older age being risk factors is a longer history of gallstones and increased number of acute attacks of cholecystitis. Besides, elderly patients have a higher likelihood of complicated biliary pathology[22,23].

Overall total billirubin, AST, ALT and ALP was noted 0.94 mg/dl, 63.5 IU/l, 59.8 IU/L and 139.8 IU/L. About 48 (43.64%) cases co-morbid conditions were reported in the present study. Other biochemical parameters such as FBS, HDL cholesterol, AST, ALT, and total bilirubin were not found to be independently associated with GSD[1].Liver enzymes (AST and ALT) and total bilirubin were not significantly associated with gallstone formation, consistent with the findings of Sun *et al*[24]. It was concluded from our study that difficulty arises during the course of surgery if wall thickness is increased in pre-operative ultrasonography. GB wall thickness has been identified as a risk factor for conversion. The critical thickness of GB wall associated with conversion varies from study to study. It was 3mm to 6mm in different studies. In a study conducted by Lal[25]., Nachnani and Baki who considered GB wall thickness to be the most important sonographic risk factor of conversion to open cholecystectomy[26].

In our study nil patients were converted to open cholecystectomy from 45 (40.91%) patients found to be difficult/very difficult on preoperative evaluation. Moreover, no cases were converted to open from 65 (59.09%) patients found to be easy on preoperative evaluation..The conversion rate in various studies was found to vary between 2.6% and 7.7%[17,27]. The conversion rate in series of Liu et al. was reported to be 13.1% in thick wall gall bladder as compared to 7.2% in normal gall bladder, however, they considered gall bladder thickness as 4mm as significant[28]. The conversion rate in our study was found to be nil patients, which was higher to the conversion rate found in the majority of the studies. According to another study, male patients were 2.3 times more likely to need conversion to open cholecystectomy as compared to female patients (P = 0.004)[29]. According to several other studies, male gender was not found to be an independent risk factor for conversion to open cholecystectomy[30,31]. Higher incidence of difficult LC and higher conversion rate in male patients have been reported which varied from 5.9% to 41% as compared to 7.18% to 59% in female[26, 32, 33]

The decision to convert to open cholecystectomy is usually taken after a considerable time has been spent on trying to successfully perform the laparoscopic procedure. A significant delay in this decision can result in increased morbidity and mortality[17]. Dhanke PS et al determined the

predictive factors for difficult laparoscopic cholecystectomy and reported that high BMI, history of prior hospitalization, palpable gallbladder, impacted stone and pericholecystic collection are significant predictors of difficult laparoscopic cholecystectomy[34].

Nachnani J et al evaluated pre-operative prediction of difficult laparoscopic cholecystectomy using clinical and ultrasonographic parameters and reported that body mass index >30 kg/m^2, male gender, past history of acute cholecystitis or pancreatitis, past history of upper abdominal surgery and thickness of gall bladder wall more than 3 mm are significant predictable factors of difficult cases[26]. Oymaci et al[35] reported a rate of conversion of 27.9%, Nachnani J et al[26]reported 11.4% cases whereas Singh K et al[36] reported a rate of conversion of 0.36%, Ishizaki Y et al[37] of 5.3% and Bakos E et al[38] as 5.7%.

Conclusion

The present study was commenced to identify the factors that can predict difficulty in laparoscopic cholecystectomy and thus complications can be prevented beforehand. The present study assessed various operative predictors for laproscopic cholecystectomy and found that obesity, co-morbid diseases, previous history of acute cholecystitis or pancreatitis, delayed surgery after 72 hour of gall bladder inflammation, increased thickness of gallbladder, adhesions with other structures, multiple stones, size of calculi more than 1 cm are significant factors that result in difficult and very difficult surgical procedures. Ultrasonographic finding of thickened GB wall greater than 4 mm, multiple stones and stone impacted in Hartmann's pouch are factor responsible for difficult LC. These factors can predict difficulty to be encountered during surgery and help in making a decision for conversion thus shortening the duration of surgery and preventing unnecessary complications.

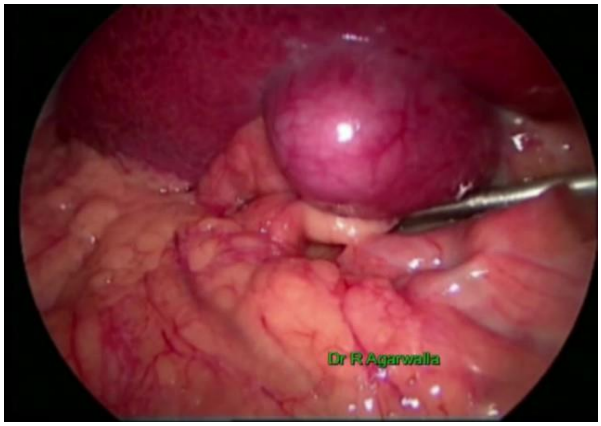

Fig 1: A case of acute cholecystitis

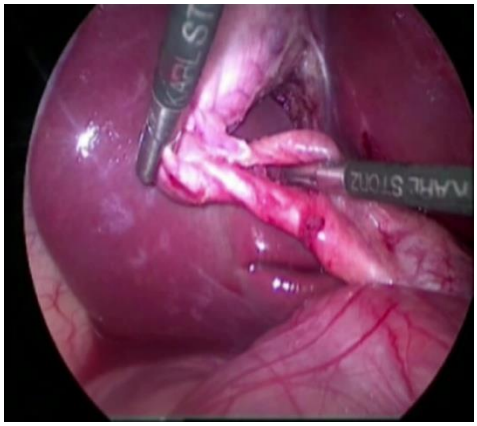

Fig 2: Critical view of safety during laparoscopic cholecystectomy

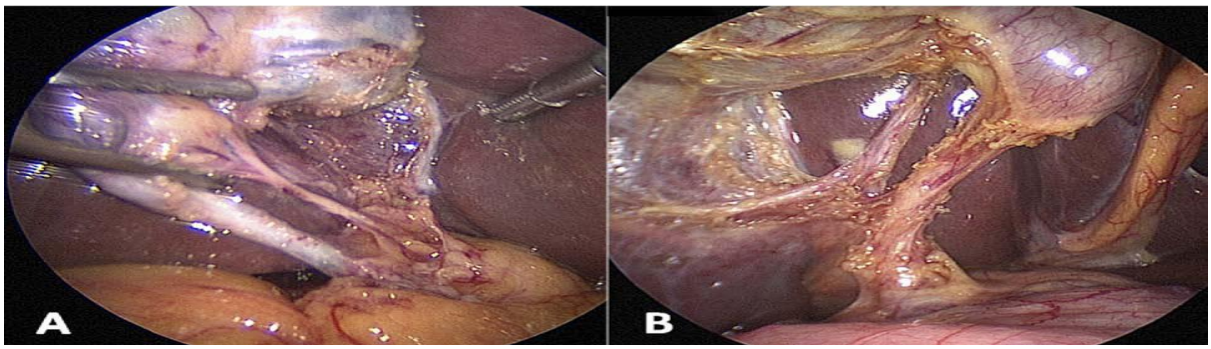

Fig 3: Critical view of safety during laparoscopic cholecystectomy

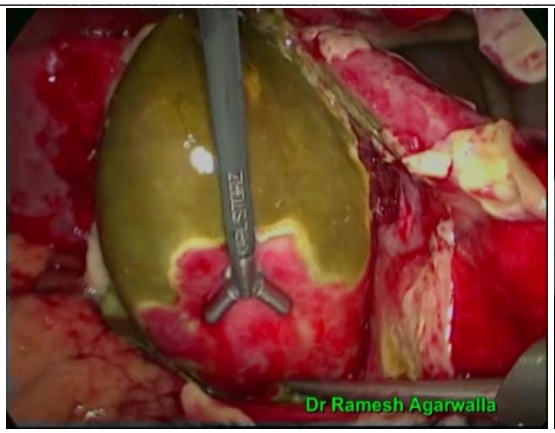

Fig 4: Gangrenous gallbladder

Fig 5: Perforated gangrenous gallbladder

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