

Laparoscopic Fundus First, Lumen Guided Subtotal Reconstituting Cholecystectomy For Difficult Cholecystectomy: A Prospective Study

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Abstract

Introduction: Laparoscopic cholecystectomy is the standard surgical procedure for gallstone disease. Difficulties could face the surgeons regarding the identification of the Critical View of Safety. Many techniques that are called salvage or bail-out techniques had been developed to deal with such conditions. We investigated a combination of three techniques namely laparoscopic fundus first lumen guided sub-total reconstituting cholecystectomy as another option.

Methodology: A prospectively collected data from 1783 laparoscopic exploration of gallstone disease. Data on patient demographics, (Nassar) operative difficulty grade, operative time, perioperative complications, and mortality were recorded.

Results: One hundred twenty-six patients were found to have Nassar difficulty grade above 3 and were involved in this study of whom 39 were males and 87 were females with average age of 49.9 years. The difficulties were dense adhesions at Calot's, Hartman's pouch stones, short wide cystic duct, and small contracted and gangrenous gall bladder respectively. There is one incidence each of conversion surgery, CBD stone, biliary fistula, paralytic ileus, and port site infection and we report two cases of sub-hepatic collection. Conversion to open cholecystectomy was done in one patient in whom difficulties still even with such measures. The mean duration of our surgical procedure was 70.1±18 minutes; a result that is statistically significant more than the classical procedure where the critical view of safety was visualized and less than that when each technique was performed separately. The sub-hepatic drain was put routinely in all salvage techniques to minimize post-operative Sub hepatic collections. triple techniques significantly decreased the incidence of bile duct injuries and hence open conversion when compared with conventional procedures in difficult cholecystectomy but not in simple ones. Mortality is a very rare complication. In all techniques. only a few cases have been reported but for a cause unrelated to the procedure. For the same reason; the triple technique is associated with a statistically significant reduction in post-operative hospital stay when compared with classical techniques related to the dramatic reduction in the associated complications.

Conclusion: A combination of three salvage techniques namely, laparoscopic fundus first subtotal reconstituting cholecystectomy will help to minimize but not eliminate the complications associated with operation to difficult gall bladder and will assist the surgeon in managing difficult operative conditions.

Keywords: Laparoscopy, cholecystectomy, Nassar operative, salvage techniques

Introduction

Laparoscopic cholecystectomy is the standard surgical procedure for gallstone disease and it is the commonest laparoscopic procedure worldwide [1, 2]. Difficulties could face the surgeons regarding the identification of the Critical View of Safety (CVS). Such difficulties are not clearly defined yet and they can vary depending on the surgeon's experience, Increased procedure time, trouble dissecting Calot's triangle or gallbladder, and complications occurring during cholecystectomy are all examples [3, 4]. Thus a scale is needed that is based on preoperative and intra-operative findings and could define the difficulty of laparoscopic cholecystectomy, which, regardless of the surgeon, will not change. Multiple scales such as Parkland, AAST, Cuschieri, or Sugrue [5-7], have been described but the most practical one is that described by Nassar et al., in 1995 [6, 8] as described in Table (1).

This difficulty scale was modified in 1996 in the reference cohort to include a grade of 5 with a grade of 4 for the analysis [8].

Patients with an intra-operative difficulty scale of 3-4 are regarded as difficult has an increased risk of vascular and

biliary duct injuries; which is Such injuries although rare but carry high mortality and morbidity [9].

Table 1. Intra-operative difficulty scale [8]; Easy: 1–2, difficult: 3–5.

Grade 1	Gallbladder—floppy, non-adherent Cystic pedicle—thin and clear Adhesions—simple up to the neck/Hartmann's pouch
Grade 2	Gallbladder—mucocele, packed with stones Cystic pedicle—fat laden Adhesions—simple up to the body
Grade 3	Gallbladder—deep fossa, acute cholecystitis, contracted, fibrosis, Hartmann's adherent to common bile duct, impaction Cystic pedicle—abnormal anatomy or cystic duct—short, dilated, or obscured Adhesions—dense up to fundus; involving hepatic flexure or duodenum
Grade 4	Gallbladder—completely obscured, empyema, gangrene, mass Cystic pedicle—impossible to clarify Adhesions—dense, fibrosis, wrapping the gallbladder, duodenum, or hepatic flexure difficult to separate
Grade 5	Mirrizi's type 2/higher, cholecysto-cutaneous, cholecysto-duodenal, or cholecysto-colic fistula

Many techniques that are called salvage or bail-out techniques had been developed to deal with such

conditions; termination of the entire procedure, fundus first technique, partial or subtotal cholecystectomy, lumen guided, laparoscopic cholecystostomy and finally conversion to open procedures [10-19], which should always remain a consideration and done for the right reasons. Conversion may allow the surgeon to gain better exposure, control bleeding, place sutures when doing so laparoscopically would be difficult, and get better "feel" for the tissues and a marker of good practice [20]. However, simply converting to an open operation in difficult situations is often not an adequate "bailout" as a difficult laparoscopic cholecystectomy remains a difficult open cholecystectomy. It increases the operative time, perioperative costs, the length of hospital stay, and a doubtful role in minimizing complications [13-19]. Recently, it had been found that the most severe biliary and hepatic artery or portal vein injuries often occur after conversion from laparoscopy to open cholecystectomy [20-24].

A common salvage technique is a subtotal cholecystectomy, where a gallbladder remnant is left in situ. Institutions have adopted subtotal with great success, observing a decline in the rates of iatrogenic ductal injury as the concept of subtotal has gained popularity [13, 14, 27, 28]. Nevertheless, these patients suffer higher rates of less severe peri-operative complications. Retained stones and bile leaks are a natural consequence of the technique, and cases of biliary fistulas and recurrent cholecystitis have been reported. As a result these patients frequently require further imaging or intervention, particularly ERCP [29, 30].

Lumen-guided method; previously named laparoscopic modified subtotal cholecystectomy [31], is a method aimed to utilize the lumen to guide further dissection to achieve cystic duct control. It is hoped that this technique will reduce the risk of these postoperative complications, particularly that of bile leak and the need for ERCP. also, avoid new stones forming in the gallbladder remnant. This also avoids a completion cholecystectomy at a later stage which may be indicated but would likely be even more challenging due to further episodes of inflammation and additional adhesions [19, 32-34].

Fundus-first dissection offers an alternative retrograde dissection technique. Although this has been performed safely by many institutions both as a routine and salvage technique; it can make retraction of the liver more difficult as the gallbladder is detached from the liver bed, and there are concerns about the high rate of ductal and vascular injuries [20, 21, 24-26] as it may encourage the dissection to drift too close to major biliary and vascular structures as it nears the neck of the gallbladder and porta hepatis. This commonly occurs when the cystic plate contracts and shortens from inflammation and even a short dissection along it can lead the surgeon into the right portal pedicle sheath (which is connected to the cystic plate). In some cases, this technique has been blamed to be the cause of vascular and biliary injuries with potentially dangerous consequences. it is also reported as not a suitable option in liver cirrhosis and left-sided gall bladder [35].

This study aimed to evaluate a new strategy that includes a combination of three salvage techniques namely; fundus

first, lumen-guided subtotal reconstituting cholecystectomy on patients that had a difficult cholecystectomy, and compare the results with some studies that evaluate each technique individually.

Materials and Methods

Study design and setting

The study was carried out in the surgical unit, of Basrah teaching hospital in Basrah governorate. A prospectively collected data from (1783) laparoscopic exploration of gallstone disease performed by a single surgeon from March 2009 to October 2022. Data on patient demographics, (Nassar) operative difficulty grade, operative time, perioperative complications, and mortality were recorded.

Ethics

Written approval from the ethical committee of the Department of Surgery, Basrah College of Medicine, University of Basrah. After taking informed consent and taking a detailed history, their demographic data details were recorded in the hospital database.

Inclusion criteria

Patients of any age from both gender who were diagnosed to have gallstones on ultrasound abdomen and already scheduled for emergent or elective laparoscopic cholecystectomy and had ASA grade I and II on preoperative assessment. Informed consent was taken from all the patients included in the study.

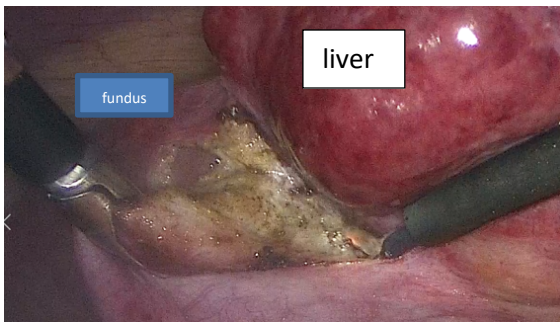
Exclusion criteria

Patients with associated CBD stones; those with suspicion of gall bladder malignancy based on ultrasound & CT findings, those who had acute cholecystitis and did not accept the risk of conversion, pregnant females in the first and third trimester, those who underwent laparoscopic cholecystectomy simultaneously with another surgical procedure and those who had child C liver cirrhosis or ASA 3 or 4 on pre-operative assessment.

Procedures

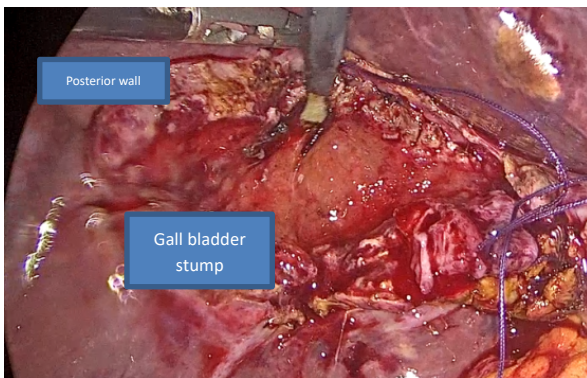
All procedures were done by a single surgeon and were explained to the patients & written informed consent was obtained. Laparoscopic cholecystectomy was done using the standard technique with 4 ports, electrocautery, and a 30° laparoscope. The initial step was to place a grasper on the fundus of the gallbladder and elevate the liver to expose Calot's triangle which is then dissected to expose the arterial and biliary structures. If difficulties were encountered while removing the tissue surrounding the Hartmann pouch or if the cystic duct was dilated and anatomical identification was uncertain; the cause of such difficulty was recorded and followed by a combination of fundus first dissection of gall bladder, lumen guided and subtotal cholecystectomy.

Retrograde or "fundus first" dissection was started with Sharp dissection using electrocautery between the liver bed and the fundus as shown in the picture (1), however near the neck of the gallbladder blunt and hydro dissection was used.



Picture (1) fundus first dissection in patients with difficult cholecystectomy.

Then the anterior wall of the gallbladder is incised at the level of Hartmann’s pouch with a transverse incision using hook dia-thermy and the gallbladder lumen is entered. Gallbladder stones are removed into a retrieval bag and bile is suctioned until its lumen is cleared. A stump was formed which would not be closed unless a free passage of bile from the gall bladder remnant is shown in the picture (2).



Picture (2) final procedure. The posterior wall was adherent to the liver.

If the posterior wall of the gall bladder was adherent to the liver bed; the mucosa was cauterized with spray coagulation using monopolar electrocautery. If the liver could not be retracted safely by a simple grasping instrument then a fixed fan liver retractor was inserted. Sub-hepatic tube drain was put in routinely. Open conversion is still a decision by the attending surgeon. The inability to identify the gall bladder due to dense adhesion (picture (3)) and uncontrollable bleeding were factors that encouraged open conversion. Complications were also recorded and a mortality at 30 days was studied.

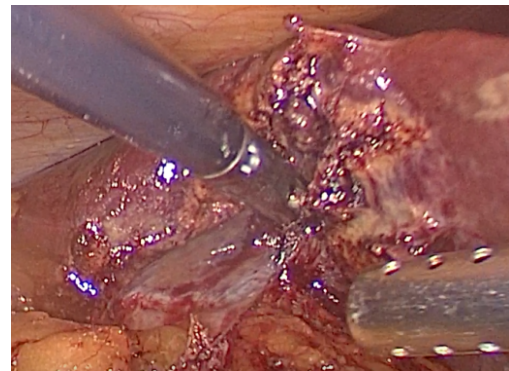
Statistical analysis

Statistical analysis was performed using SPSS version 16.0. Continuous variables were calculated as mean±SD. P<0.05 was considered a statistically significant range (IQR) or a number and percentage (%), as appropriate. Chi-squared test was used to compare the proportion of categorical variables.

Results

The total number of patients undergoing laparoscopic cholecystectomy was 1783. Of these, 1246 were female (69.8%) and 537 were male (30.1%). The mean age was 47.6 years ranging between (16-79) years. Difficult dissection was encountered in 126 (7%) patients. Table (2) shows the

demographic distribution of those patients and the causes of difficult dissection in addition to post-operative complications.



Picture (3) Thick fibrosed gall bladder.

Table 2. Demographic distribution of all patients.

Total number (1783)	Triple technique cholecystectomy (126) (7%)	Conventional lap. cholecystectomy (1657) (93%)
Male	39 (31%)	498 (30%)
Female	87 (69%)	1159 (70%)
Mean age	49.9 years	46.2 years
Range of age	29-81 years	30 - 68 years
Mean operation time (min)	64.9	41.5
Causes of difficulties		
Grade	III (78, 62%) IV (48, 38%) I (1288, 77.7%) II (369, 22.3%)	
Dense Adhesions At Calot’s	54	-
Hartman’s Pouch Stones	43	-
Short Wide Cystic Duct	26	-
Small Contracted Gall Bladder	2	-
Gangrenous gall bladder	2	-
Mirizzi’s Syndrome	-	-
Conversion	2 (1.6%)	-
Stony, fibrotic gall bladder	1	-
Post-operative complications	6 (4.7%)	
CBD stone	1(0.8%)	1(0.08%)
Biliary fistula	1(0.8%)	-
Paralytic ileus	1(0.8%)	-
Sub-hepatic collection	2(1.6%)	-
Port-site infection	1(0.8%)	-

The mean duration of surgery in the triple technique group was 70.1±18 minutes and ranged between 35-120 minutes. The main postoperative hospital stay was 2.3 ± 0.9 days and ranged between 2-8 days. Only one patient was re-admitted due to a low-output biliary fistula that was managed conservatively. Also, one patient was re-admitted on the seventh postoperative day complaining of severe abdominal pain, jaundice, and fever and discovered to have a stone in the common bile duct which was dealt with by ERCP and sphincterotomy. The sub-hepatic collection developed in two patients; one diabetic male presented with swinging fever on the sixth postoperative day. the other was 30 years woman with intra-operative spillages of stones followed by a vigorous wash with isotonic saline. Both were managed with aspiration and drainage under ultrasonic guidance. One elderly woman converted to open cholecystectomy due to extensive fibrosis around the liver with difficult dissection.

The postoperative pathology showed acute cholecystitis in all cases, including 2 cases (1.6%) of gangrenous cholecystitis.

Discussion

The present paper describes a combination of three salvage techniques termed laparoscopic fundus first lumen guided subtotal reconstructing cholecystectomy. Hundred twenty-six cases are reported in patients where the critical view of safety could not be established due to different causes that make their Nasser difficulty grading three or more. The incidence of difficult cholecystectomy in our study is 7% which is contrary to previous studies [11, 13, 29, 36] that report an incidence ranging between (10-15%) but may be reached 29.4% in some studies and 51.72% in others [13, 36]. This discrepancy may be secondary to differences in the rate of urgent and elective procedures for gallstone diseases and also depends on the method used to classify the difficulty of the surgical procedure. The major reasons to classify a cholecystectomy as difficult are the severity of the disease, the presence of adhesions with consequent anatomical alteration, the laparoscopic experience of the surgeon, and the devices available for surgical treatment [11, 34]. Despite the operative difficulty, gaining access to the fundus and lumen facilitated the safe progression of the operation and ensured complete resection of Hartmann's pouch with cystic duct control in the majority. In our experience, gaining access to the gallbladder through Hartmann's pouch via a combination of three salvage techniques allowed the surgeon both to visualize the extent of the gallbladder and to delineate the anatomy of the cystic duct. Compares our results with some other studies that discuss each technique separately [13, 14, 24-26, 32].

The mean duration of our surgical procedure was 70.1±18 minutes; a result that is statistically significantly more than the classical procedure where the critical view of safety was visualized and less than that reported by Abdul Basset et al, Michael D Kelly et al and İsmail Cem Sormaz et al respectively. In all these cases decision for retrograde dissection was made after time spent to visualize a critical

view of safety. The variation in the operation time also depends on the variation in the surgeon's experiences and adoption of pre-operative parameters that anticipate the difficulties and directly start the salvage techniques saving much time of dissection [13-19].

A sub-hepatic drain was put in all cases of difficult cholecystectomy that were operated by triple salvage technique to minimize post-operative Sub hepatic collections which are usually described as a non-infective (mostly blood or remnant of washing fluid collection) but an abscess can also be present. Some of these collections can be resorbed without any clinical signs or complications. Strasberg SM, Adriana Toro, and Ali Cihat Yildirim et al [13, 14]) concluded that a frustrating but not reconstituting form of subtotal cholecystectomy is associated with a higher incidence of intra-abdominal collection. Adriana Toro et al in their large systemic review attributed a direct relationship between the incidence of sub-hepatic collection to the gallbladder wall being left open. Thus it becomes mandatory to drain the abdomen at the end of the surgical procedure. the First to avoid more complications and the second to understand the patient's needs and timing for treatment [37].

Since the introduction of laparoscopic cholecystectomy; there has been a sharp rise in the incidence of bile duct injuries in comparison to open surgery from 0.2% to 1.1% [36-38], with a rate of 4.8% for cholecystectomies finished after conversion to open surgeries and it remains one of the most serious iatrogenic surgical complications [39]. all studies that discuss salvage techniques including our results conclude that these techniques significantly decreased the incidence of bile duct injuries when compared with conventional procedures in difficult cholecystectomy but not in simple ones [18, 37]. The only exception is that reported by Sormaz et al [26] who noticed a 7.7% incidence of bile duct injuries in his series. In our opinion; a combination of three salvage techniques can be tried in addition to the opinion of an older surgeon in case of difficulties is strongly recommended before conversion to open surgery.

Table 3. Comparison between triple salvage techniques with previous studies. Categorical variables are presented as No. (%).*P-value<0.05 *Considered significant; FFC=fundus first cholecystectomy.

Procedure (By references)	No.	Duration of operation (minutes)	No. of sub-hepatic collection cases (%)	No. bile duct injury cases (%)	No. bile duct Leakage cases (%)	No. conversion cases (%)	Mortality cases (%)	Retained stone (%)	Duration of hospital stay (minutes)
FFC Abdul Basit Saeed [24]	41	46.44 ± 6.71*	6 (14.6)*	-	-	3 (7.3)*	-	-	3 ± 0.1*
FFC Michael D Kelly [25]	11	57 ± 4.8	3 (27.3)	-	-	2 (18.2)	1 (9.1)*	-	2.2 ± 0.12
FFC İsmail Cem Sormaz [26]	13	87 ± 34	1 (7.7)*	1 (7.7)*	1 (7.7)	-	-	-	2.76 ± 2.48
Sub-total Cholecystectomy Strasberg SM [13]	46	68 ± 6	6 (13)*	1 (2.2)	5 (10.9)*	3 (6.5)*	1 (2.2)*	-	2.4 ± 4
Subtotal Cholecystectomy Adriana Toro [14]	678	57 ± 33*	10 (1.5)	18 (2.7)	83 (12.2)*	2 (0.3)	3 (0.4)	12 (1.8)*	2.6 ± 6.7
lumen guided James Lucocq [32]	27	116 ± 43	2 (7.4)*	-	-	-	-	-	2 ± 3.9
Classical İsmail Cem Sormaz [26]	13	46.12 ± 5.98*	1 (7.7)*	1 (7.7)	1 (7.7)	-	-	-	1.28 ± 0.56
Classical James Lucocq [32]	27	115 ± 12	1 (3.7)*	-	1 (3.7)	-	-	-	1.24 ± 0.8

Our Triple technique	126	70.1 ± 18	2 (1.6)	-	-	2 (1.6)	0 (0)	-	2.3 ± 0.9
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The timing of open conversion was decided by the attending surgeon. It was mentioned that the inability to identify the cystic duct and gallbladder artery within 1 hour and uncontrollable bleeding were factors that encouraged open conversion(18). There is a wide variation in the reported conversion rates to open surgery during laparoscopic cholecystectomy between 1% and 24% [39, 40]. The conversion rate can be as high as 44% during laparoscopic cholecystectomy in patients with acute gangrenous cholecystitis [17, 40]. the conversion rate to open surgery decreased from 5.2% to 1.2% with the use of different salvage techniques. Gupta et al. [41] reported that the use of the Fundus First technique decreased the conversion rate from 18.8% to 2.1% in patients with chronic cholecystitis. Our results are similar to that reported by Hussain et al who conclude that combining subtotal cholecystectomy and the fundus first technique resulted in a decreased rate of conversion [42].

Conversion is not a failure but a wise decision when the surgeon realized the procedure to be converted to avoid all complications. Surgeons around the world, after an initial period in which the majority of them were convinced that the procedure had to be completed by laparoscopy, realized that the procedure had to be converted to avoid all complications. This realization was because difficult cholecystectomy had a stable number of complications in open surgery compared to laparoscopy [43-47].

Laparoscopic cholecystectomy is one of the more unpredictable operations in general surgery with an associated mortality of 0.45 to 6% depending on the severity of gallbladder disease [40-43].

Mortality is a very rare complication. in all techniques. only a few cases have been reported but for a cause unrelated to the procedure [40].

All salvage techniques are associated with a statistically significant reduction in post-operative hospital stay when compared with classical techniques related to the dramatic reduction in the associated complications [38-41].

A limitation of our study is that it is an observational study with outcomes based on subjective assessments, where potential bias must be taken into consideration. Comparing the surgeons' estimates of performance and difficulty is complicated since they are based on personality and previous experience. Another limitation of our study is the lack of long-term follow-up and hence analyzing the related complications.

Conclusion

Safety is the primary goal of laparoscopic cholecystectomy, total cholecystectomy being the second. While the majority of laparoscopic cholecystectomies performed will be straightforward, the surgeon should always keep this culture of safety. A combination of three salvage techniques will help minimize but not eliminate the complications associated with operation on a difficult gall bladder and will assist the surgeon in managing difficult operative conditions or clinical scenarios.

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