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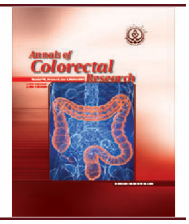

The Effect of Various Surgical Techniques on Difficult Cholecystectomy Operations: A Retrospective Cohort Study

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Abstract

Background: Success of laparoscopic cholecystectomy depends on multiple factors. Knowledge about altered anatomy, physiology and pathology of the gall bladder, and the surgeons experience in applying different surgical techniques during difficult cholecystectomy operations are collectively important for attaining safe outcomes.
Methods: Data pertaining to a total of 875 patients who underwent cholecystectomy from June 2014 to May 2019 were analyzed. The study was mainly focused on looking for various intraoperative findings that could be the reason for conversion to open cholecystectomy in patients with difficult anatomy, physiology or pathology associated with gall stone disease.
Results: About 279/875 (31.9%) had difficult gall bladder operations with altered anatomy and pathology. Overall, conversion rate among difficult laparoscopic cholecystectomy was 62/279 (22.2%). A total of 36/875 (2.4%) patients underwent subtotal cholecystectomy. Repair of common bile duct injury was performed in 1/875 (0.1%) cases. The overall complication rate was 54/875 (6.4%); 1/875 (0.1%) died due to sepsis.
Conclusion: High conversion rate and complications are seen in patients with contracted gallbladder and adhesions due to previous interventions. Conversion from laparoscopic cholecystectomy to open cholecystectomy is not a complication but continuum of treatment to reduce morbidity. Use of the critical view of safety technique is very useful.

Keywords: Difficult laparoscopic cholecystectomy, Conversion to open surgery

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Introduction

Laparoscopic cholecystectomy (LC) can occasionally be a challenging procedure. Apart from patient's comorbidities and presurgical interventions (endoscopic cholangiography, endoscopic papillotomy, bile duct stenting, cholecystostomy, etc.), surgical outcomes also depend on various intraoperative findings like altered anatomy, physiology and pathological changes that occur in the region of gall bladder, bile duct and the surrounding tissue owing to gall stone disease. A well-explained consent describing risk factors about contemplated intraoperative difficulties and their possible surgical steps is necessary. Beginners should start with simple cases prior to venturing into difficult cases (1). The goal of the surgery in benign conditions of symptomatic gall stone disease should be to reduce morbidity; therefore, a lower threshold should be maintained for conversion of LC (c-LC) and preventing injury to surrounding vital structures. The complications and outcomes in difficult LC are often dependent on the surgeon's experience to handle altered anatomy and pathology of Calot's triangle (1). We understand that every difficult case of symptomatic gall stone disease taken for surgery is a chapter in itself that needs different surgical techniques for attaining successful outcomes. The aim of the LC should be to give a better cosmetic outcome with minimal postoperative morbidity.
To study intra-operative causes of difficult cholelithiasis and risk factors responsible for c-LC.

Methods

Study Design

A retrospective cohort study of patients who underwent LC in the Department of Surgery, All India Institute of Medical Sciences, New Delhi from June 2014 to May 2019 was performed. The indications for cholecystectomy were: recurrent biliary colic, cholecystitis, biliary pancreatitis, and common bile duct stone (CBDS). Statistical analysis was performed using SSPS 18. Parametric data were measured as means and standard deviation. Non-parametric data were expressed as frequencies and percentages. Paired t test and non-Fishers exact test were used where applicable. Statistical significance was defined as $P<0.05$.

Patients

Data pertaining to a total of 875 patients who had undergone cholecystectomy during the study period were analyzed. Patient's demography such as age and gender, symptoms, findings on endoscopic retrograde cholangio-pancreatography (ERCP) and magnetic resonance cholangio-pancreatography (MRCP), operative details, causes for conversion to open cholecystectomy, and complications (intraoperative and postoperative) were collected from the hospital record.

Preoperative Management

Patients were evaluated via complete hemogram, liver function tests, abdominal ultrasonography, and ERCP and / or MRCP (where indicated).

Surgical Procedure

Generally, surgical procedures consisted of total cholecystectomy and subtotal cholecystectomy. As a matter of policy, we place drainage in all LC with bile spillage and significant bleeding. The cholecystectomies were performed by consultant and trained surgical residents under supervision. Insufflation was routinely performed using the Veress needle inserted through the umbilical port except in cases with past history of previous abdominal surgery, where the Veress was inserted about 3 fingers below the left sub-costal region in the mid-clavicular line for insufflation. Subsequently, surgery was performed using the four port standardized technique with the operating surgeon standing on the patient's left (except in situs inversus totalis, where the surgeon stood on the right side). In the majority of cases, electrical cautery was used for dissection of Calot's triangle, and it was necessary to ensure critical view of safety (CVS) in all the patients. In cases of adhesions, the harmonic scalpel was routinely used. Gall bladder was dissected from the liver bed using either the cautery hook or the harmonic scalpel.

Postoperative Management

Following LC, patients were discharged on the same day or one day after surgery. Patients with open surgery were kept for 3 to 5 days post-operatively. MRCP with or without ERCP-and-sphincterotomy or biliary stent was performed in patients with post-operative bile leak; these patients were discharged after removal of the drain.

Results

Out of 875 cases, 320/875 (36.6%) were male and 555/875 (63.4%) were female. Remarkably, 78.3% (685/875) of the study population was aged below 50 years of age. 298/875 (34.1%) patients had recurrent biliary colic; 24/875 (2.7%) patients had moderate pain. Cases with difficulty during LC are enumerated in Table 1. All patients had undergone evaluation by ultrasonography and were diagnosed to have gall stone disease, while 71/875 (8.1%) underwent preoperative ERCP and, subsequently, interval cholecystectomy. Only 10/875 (1.1%) patients underwent simultaneous open cholecystectomy and CBD exploration. In 18/875 (2.1 %) cases, the patient required two to three ERCP attempts for complete clearance of bile duct stones considering multiple stones. In 279/875 (31.8%) patients, we witnessed difficult cholecystectomy (Table 1). About 62/875 (7.1%) patients underwent

Table 1: Laparoscopic cholecystectomy and causes of difficult cholecystectomy (N=875)

Gallbladder without altered anatomy and pathology		596 (68.1%)
Post-endoscopic retrograde cholangio-pancreatography (ERCP) adhesions		71 (8.1%)
Previous abdominal surgery		47 (5.4%)
Obesity with extensive fat in the hepatocystic triangle		41 (4.5%)
Chronic cholecystitis inflammation with dense scarring		29 (3.3%)
Presence of large stones within the junction of the neck of the gallbladder and the cystic duct (Hartmann's pouch): Mucocele gallbladder		23 (2.6%)
Acute cholecystitis (during interval cholecystectomy)		17 (1.9%)
Choledocholithiasis and scarring adhesion formation to surrounding structures		16 (1.8%)
Gallstone induced pancreatitis with severe surrounding tissue inflammation		9 (1%)
Gangrenous changes in the gallbladder wall with fragile tissues		8 (0.9%)
Situs inversus totalis		4 (0.5%)
Liver cirrhosis		4 (0.5%)
Anatomic	Vascular	4 (0.5%)
	Biliary	4 (0.5%)
Cholecysto-cutaneous fistula		2 (0.2%)
Total		875

conversion to open cholecystectomy (Table 2). 47/62 (75.8%) were men (42/62 were above 50 years and 5/62 were below 50 years), and 15/62 (24.2%) were women (11/62 were above 50 years and 4/62 were below 50 years). Risk factors for conversion from LC to open cholecystectomy are presented in Table 2, while Table 3 summarizes the various techniques adopted for altered (distorted) anatomy and pathology associated with the gall bladder. The CVS technique was followed in all patients; however, in 36/875 (4.1%) cases, the cystic duct and artery could not be isolated separately, and the patients underwent subtotal cholecystectomy (Table 4). Overall, conversion rate among difficult LC was 62/279 (22.2%). Previous surgery and adhesions following post-ERCP cholelithiasis constituted the majority of risk factors among patients with LC converted to open surgery 18/875 (2.1%). In 1 (0.1%) patient, incomplete bile duct injury was detected during the procedure due to misidentification of structures. In 838/875 (95.7%) cases, CVS could be achieved but in 37/875 (4.2%), CVS could not be achieved (36 underwent subtotal cholecystectomy and 1 underwent subtotal cholecystectomy with end to end anastomosis of CBD). Unfortunately, 1/875 (0.1%) died due to sepsis secondary to acute cholecystitis (Table 5).

There were 54/875 (6.4%) patients who developed complications (Table 5). The most common intraoperative complication was bleeding 25/875 (2.9%), while wound infections was the most common postoperative complication (13/875; 1.5%). Complications are summarized in Table 5. Bleeding was controlled by compression using gauze piece and diathermy or Hemo-lock. A total of 13/875 (1.5%) patients developed wound infection, which was managed by conservative treatment. Also, 6/875 (0.7%) developed bile leak; two had spontaneous resolution and four required ERCP and sphincterotomy.

Discussion

Difficulties during LC may appear as a surprise; however, an experienced surgeon knows how to save himself and overcome defying tides of misfortune. The surgeon's experience converts risk factors into predictors of difficulty during the surgery. Risk factors for difficult LC include the male gender, previous abdominal surgery, cirrhosis of liver, previous interventions on bile duct or gall bladder, and acute inflammation of the gall bladder, biliary tree or surrounding structures such as the pancreas. Closely inserted instruments (ports) may result in fights between each other and difficulty to maneuver. An obese male and a thin patient pose difficulties during port insertion. Visceral injuries might occur should the force required while introducing the trocar not be guarded.

Table 2: Causes of conversion from laparoscopic to open surgery (N=62)

Contracted and thick wall gall bladder with dense adhesions between gall bladder and surrounding structures	18 (25%)
Previous surgery	12 (16.7%)
Large stone in the gall bladder neck	10 (16.1%)
Choledocholithiasis	10 (13.9%)
Gangrenous gall bladder	6 (8.3%)
Hepatocystic triangle bleeding (Gall bladder bed, adhesiolysis, and cystic artery injury and bleeding)	4 (5.6%)
Bile duct injury (misidentification of CBD): Mirizzis syndrome type 2	1 (1.4%)
Acute cholecystitis with gangrenous gall bladder)	1 (1.4%)
Total	62

Table 3: Methods adopted during the difficult cholecystectomy surgery

Condition of the gall bladder	Method adopted	Total numbers	Conversion to open surgery
Contracted gallbladder and Obliterated Calot's triangle secondary to adhesions following CBD stone, post intervention on GB or CBD, or biliary pancreatitis.	When surrounding structures were pulled towards gall bladder, fundus first (retrograde technique) dissection was adopted. Wherever Calot's dissection was feasible dissection was performed using suction (instrument) or gauze piece . Electro-cautry was generally avoided near hepatocystic triangle to prevent injury to hepatic duct.	125	29
Adhesions .	Cold scissor in the proximity of bowel and harmonic scissor for vascularized adhesions away from bowel.	48	12
Large liver and increased fat in the hepatocystic triangle.	Bariatric bed with foot board. Use of 5th port technique (an additional port placed to retract liver and neck of gallbladder).	41	0
Acute cholecystitis, liver bed bleeding, cirrhosis of liver, vascular and biliary anomaly.	Gentle tissue handling and gauze or suction dissection. Hemostasis was achieved by applying pressure with gauze or gallbladder itself; clips or hormonic scissor was preferred over monopolar electro-cautery for bleeding vessel; irrigated to identify blush or specific bleeding point. Hemostatic agents (fibrillar or surgicel) were used for surface ooze.	31	4
Tense distended gallbladder with mucocele/pyocele secondary to large stone at the neck of the gall bladder.	Aspiration first followed by gauze dissection. Gauze dissection and identification of cystic duct. Subtotal cholecystectomy in case of short cystic duct (< 3mm) or sessile gall bladder.	23	10
Gangrenous/Perforated gallbladder.	Gentle tissue handling and fundus-first (retrograde) dissection; drain placement.	8	6
Cholecysto-cutaneous fistula	Intraoperative sinogram and insertion of feeding tube. Fundus-first (retrograde) dissection; drain placement.	2	0
Misidentification and injury to CBD.	On table detection of golden bile and conversion to open surgery. CBD injury was repaired.	1	1
Total (conversion rate in difficult laparoscopic cholecystectomy was 22.2%)		279	62

Table 4: Procedure executed (N=875)

Laparoscopic	Laparoscopic cholecystectomy	782 (89.4%)
	Laparoscopic subtotal cholecystectomy	25 (2.9%)
	Laparoscopic CBD exploration	6 (0.7%)
Open	Open cholecystectomy	41 (46.8%)
	Subtotal cholecystectomy	10 (2.3%)
	Open cholecystectomy with common bile duct exploration	10 (1.1%)
	Subtotal cholecystectomy with end to end anastomosis of common bile duct	1 (0.11%)
	Total	875

Table 5: Complications

Intraoperative bleeding	Adhesiolysis	13	2.9%
	Liver bed	7	
	Cystic artery injury	5	
Post-operative complications	Wound infection	13 (1.5%)	
	Sepsis and prolonged duration of antibiotics	8 (0.9%)	
	Bile leak	6 (0.7%)	
	Common bile duct injury	1 (0.1%)	
	Sepsis and death (acute cholecystitis with gangrenous wall of gall bladder)	1 (0.1%)	
Total		54 (6.2%)	

The last two decades have seen LC to emerge as the gold standard procedure for management of symptomatic gall stone disease owing to lower procedural morbidity, duration of recovery and hospital cost relative to the previous procedure (2). However, there is a 1.5% to 6% possibility of conversion to open surgery and risk of bile duct injury (3-5). We had a 7.1% conversion rate at our center.

The male gender has also been described to be an independent factor predicting conversion to open (6). This is further supported by the findings from our series, where among those requiring conversion, 67%

were men aged higher than 50 years. This is probably due to the more frequent association with severe disease and higher proportion of intra-abdominal and visceral adipose tissue than women.

In the study of Boerma et al., (7) 47% patients developed a recurrent biliary complication and 37% required cholecystectomy. In our study, 34.1% patients had recurrent biliary colic; 24/875 (2.7%) patients had moderate pain. The most common cause for conversion from LC to open cholecystectomy in our study was contracted and thick wall gall bladder with unclear anatomy of Calot's triangle (29/875; 3.3%). In the studies of Sarli et al. and Allen et al., it was observed that preoperatively performed endoscopic cholangiography was associated with increased risk of c-LC and complications (8, 9). Similarly, Erdal Birol et al. observed that in patients with post-sphincterotomy, c-LC was 14% when compared to 4% for patients undergoing LC without post-sphincterotomy (10). In the present study, among the conversions, the majority occurred because of dense adhesions and thick contracted gall bladder walls. A high conversion rate is associated with multiple preoperative ERCP attempts (10). Our study also yielded the same results; out of 62 cases, 18 (29.0%) patients had undergone multiple ERCP attempts for bile duct clearance. In two different studies published by Rosen et al. (11) and Kuldip et al. (12), it was observed that the c-LC rate in difficult LC was 5.3% and 1.7%, respectively; the main documented reason was severe inflammation of gall bladder in the former and dense adhesion in the region of Calot's triangle in the latter. Similarly, in numerous studies, previous surgery is considered to be a significant risk factor for c-LC (13). In the present study, among patients who had underwent previous surgery, 12/47 (25.5%) required conversion to open cholecystectomy.

Intraoperative risk factors for conversion include: difficulty in port insertion owing to the adhesions and altered anatomy or pathology of the gall bladder. Pre-operative identification of biliary anatomy has been a matter of long debate. However, routine use of endoscopic retrograde cholangio-pancreatography or magnetic resonance cholangio-pancreatography for delineating biliary anatomy is not recommended (14). There is conflicting evidence regarding routine intraoperative cholangiograms for prevention of biliary injuries, and most surgeons only use it selectively (15). In the cases included in the present study, intraoperative cholangiograms were routinely obtained in all patients requiring CBD exploration.

We found that a small, contracted, thick-walled gall bladder, inflammation of the hepatocystic triangle, prior upper abdominal surgery, large stone impaction in the neck of gall bladder, Mirizzi's syndrome, and obesity are associated with morbidity and greater of risk of c-LC. We routinely follow steps of the CVS technique for identification of duct and artery prior to application of clip. In 36/875 (4.1%) cases, CVS technique could not be achieved due to frozen Calot's triangle; therefore, subtotal cholecystectomy was performed.

Conclusion

High conversion rate and complications are seen in patients with contracted gallbladder and adhesions due to previous interventions. Conversion from LC to open cholecystectomy is not a complication but rather a continuum of treatment to reduce morbidity. Use of the CVS technique prior to division of cystic duct and artery is helpful.

Conflict of Interests: None declared.

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