

# Laparoscopic Sub Total Cholecystectomy - An Alternative to Conversion to Open Cholecystectomy

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**Abstract:** *Laparoscopic cholecystectomy is a common surgical procedure for gallstone disease. It is one of the common surgical procedures taught to surgical residents. The majority of the cases can be operated without problems. Patients with acute cholecystitis, chronic cholecystitis with frozen Calot's triangle, and those with variations of biliary and vascular anatomy carry an increased risk of vasculo-biliary injuries. In these situations of difficult gallbladder surgery, the surgeon is often forced to convert to open cholecystectomy. Less than total cholecystectomy has been advocated for difficult operative conditions for more than 100 years. Conversion to Open Cholecystectomy does not guarantee adequate identification of anatomical structures and therefore does not eliminate the risk of vascular & bile duct injuries. Subtotal cholecystectomy allows for near total removal of the gallbladder and complete evacuation of the stones while avoiding dissection in the hazardous area. Laparoscopic subtotal cholecystectomy is an alternative approach to open cholecystectomy in a difficult gall bladder surgery. A retrospective study of subtotal cholecystectomy for a period of 2 years in our institution was done. 12 out of 167 laparoscopic cholecystectomies were difficult. 4 cases were converted to open surgery and 8 were managed by laparoscopic subtotal cholecystectomy.*

**Keywords:** laparoscopic cholecystectomy (LC), Open cholecystectomy (OC), Subtotal cholecystectomy (STC), Acute cholecystitis (AC), Bile duct injuries (BDI), Vasculo-Biliary injuries (VBI)

## 1. Introduction

Laparoscopic cholecystectomy (LC) was first performed by Professor Erich Muhe of Germany in 1985 under direct scope vision. The procedure using a videolaparoscope, which is used today, was carried out by Mouret in 1987<sup>[1]</sup>. In 1992 National Institutes of Health consensus concluded that it is a safe, effective treatment procedure for almost all patients with symptomatic cholelithiasis.<sup>[1]</sup> It has become a gold standard surgery for symptomatic gallstone disease replacing Open cholecystectomy (OC). It is one of the common surgical procedures taught to surgical residents. LC shows results as good as OC. It has an additional advantage of a better post-operative recovery in terms of pain, scarring, early return to work, and quality of life. The procedure involves exposure of Calot's or hepatocystic triangle (HC) and achieving Critical View of Safety (CVS) before clipping and cutting cystic duct and artery followed by dissecting gallbladder from the liver bed. LC is associated with 3-5 times more bile duct injuries (BDI) or Vasculo-biliary injuries (VBI) compared to OC<sup>[2]</sup>. Severe inflammation of the GB and its surroundings in AC increases the difficulty of LC and the frequency BDI/VBI. The estimated incidence of serious complications such as BDI and VBI is 2-5 times higher for LC than for open cholecystectomy.<sup>[1]</sup> Major BDI is a serious complication with an increase in morbidity and mortality. In addition, patients with BDI require further interventions with increased risk of additional complications and suffer a decreased quality of life.<sup>[2]</sup> Pre-operative assessment of predicting risk factors suggests LC may be difficult or abnormal was done in many studies. Risk factors for the Difficult Gallbladder include Elderly age (>65 years), Male gender, and morbid obesity. Presenting history of, AC more

than 72-96 hours since the onset of the symptoms, chronic cholecystitis with thick-walled or contracted/shrunken gallbladder, multiple episodes of biliary colic, previous episodes acute cholecystitis or pancreatitis. White blood cell count >18,000/dl, palpable gall bladder, gangrenous or perforated gallbladder, Mirizzi's syndrome or cirrhosis of Liver (especially with portal hypertension), and previous open upper abdominal surgery<sup>[2]</sup> are also considered as risk factors. Ultrasound findings of risk are GB wall thickness of 4mm or more, pericholecystic fluid, dilated cystic or biliary ducts.<sup>[2]</sup> But Predictions for a difficult LC may be arbitrary since it is also dependent on the surgeon's experience and perception<sup>[3]</sup>. Intra-operative assessment of difficulty in procedure was graded by Nasser scale from grade 1-4<sup>[3]</sup>. The Nassar scale allows for a difficult LC to be described easily by considering the nature of the disease, the visibility of the organ, the condition of the cystic pedicle, and the possibility of clearly establishing the CVS. Grade 3 & 4 are usually the cases with difficult Calot's triangle and difficult to achieve Critical View of Safety. In difficult GB surgery despite of adequate precautions, identification of local anatomy and CVS may not be achieved due to dense fibrosis and adhesions in HC. Bleeding and bile leak are additional factors. In difficult GB surgery, bail-out procedures are advocated by Tokyo Guidelines 2018 (TG18).<sup>[1]</sup> The Tokyo Guidelines 2018 (TG18) indicate a clear strategy for such cases and recommend the use of bail-out procedures, and subtotal cholecystectomy (STC) as an option to prevent BDI or VBI. The SAGES safe cholecystectomy task force 2015 (STFC) also advises STC as a bail-out technique.<sup>[4]</sup> Bail-out techniques advised are open cholecystectomy, cholecystostomy, fundus first laparoscopic cholecystectomy and laparoscopic subtotal cholecystectomy. Subtotal or partial cholecystectomy is a known procedure for more than

100years to avoid BDI. Conversion of Laparoscopic cholecystectomy to open cholecystectomy is an option to avoid complications of BDI. Subtotal cholecystectomy by laparoscopic or open methods has been reported to reduce BDI.<sup>[1]</sup> It is well recognised that conversion to OC does not always allow complete standard dissection and avoid vasculo-biliary injuries (VBI).<sup>[6]</sup> Conversion to OC leads to loss of advantages of laparoscopic surgery with increased post-operative pain, delayed mobility, prolonged hospitalisation, post-operative adhesions, and risk of incisional hernia formation. Laparoscopic procedures such as fundus first approach, cholecystostomy & Laparoscopic subtotal cholecystectomy (STC) are other recommended procedures. Cholecystostomy needs a second stage procedure with additional problems and no guarantee of completion cholecystectomy. Strasberg found out that extreme vasculo biliary injuries tend to occur when fundus-down cholecystectomy is performed in the presence of severe inflammation. Contractive inflammation leads to thickening and shortening the cystic plate, making separation of the gallbladder from the liver hazardous<sup>[7]</sup>.

Sub Total Cholecystectomy (STC) is an option in cases with a) difficulty of dissection in Calot's triangle due to fibrosis and adhesions b) dense adhesion of GB with liver, in cases of GB disease with cirrhosis of liver or portal hypertension<sup>[8]</sup> c) both a & b. STC is 2 types - 1) Fenestrating. 2) Reconstituting. STC is a procedure where the gallbladder is opened in the safe zone above the R4U line at the level of Hartman's pouch and all stones are removed. GB is dissected off the Liver bed if possible, otherwise the anterior part of the GB is excised and the posterior wall of GB is left in situ with the Liver. The mucosa of the remaining GB is cauterised. In Fenestrating type of STC the cystic duct opening is closed internally by a suture and GB is left open. In Reconstituting STC the remnant of GB is sutured and a small pouch of Gallbladder is left behind. Each has its own merits and demerits. In Fenestrating STC bile leak is more common which may need further interventions like CBD stenting by ERCP. Reconstituting STC leaves behind a small pouch of neoGB. It can predispose to cholecystitis, stones and, a rare chance of malignancy in the remnant GB. Technically Fenestrating type of STC is difficult than Reconstituting STC. Subtotal cholecystectomy is a definitive operation that prevents recurrent gallstone formation, as no residual diseased gallbladder mucosa is left in continuity with the biliary system. It provides a simple, safe option in patients in whom cholecystectomy could be hazardous<sup>[8]</sup>. It also helps to finish LC in single stage without BDI.

## 2. Materials & Methods

This is a retrospective study conducted in our institute over a 2 years period. A total 167 of laparoscopic cholecystectomy were done. Standard 4 port laparoscopic cholecystectomy was done under general anaesthesia. A difficult gall bladder was anticipated when Nasser grade 3/4 or fibrotic adhesions of Calot's is recognised. An attempt was made to dissect and achieve Critical View of Safety. When CVS could not be achieved after an adequate attempt of time (usually 30 minutes of Calot's dissection) a bailout was considered after a consultation with another surgeon. A total of 12 cases were difficult and 4 were converted to open cholecystectomy

(OC), 8 cases were completed laparoscopically with STC. The indications were Ac cholecystitis (4), Chronic Cholecystitis fibrotic Calot's triangle (7), Mirizzi syndrome (1). Out of 8 Laparoscopic STC 3 were done by Fenestrating technique & 5 were Reconstituting technique. GB was opened at infundibulum above Rouviere's sulcus, all stones were evacuated. Mucosa of the remnant GB was cauterised in all cases. The procedure was completed either by Fenestration or Reconstitution technique. A drain was given in all cases. Post-operative complications were bleeding, bile leak and Wound infections were noted.

## 3. Results

Total Number Cholecystectomy - 167

Acute Cholecystitis - 44

Chronic Cholecystitis - 123.

Bail-Out - 12

Open Cholecystectomy - 4.

Laparoscopic Sub Total Cholecystectomy - 8

Fenestrating - 3

Reconstructing - 5.

### Post Operative Complications:

- **Bleeding** is common due to prolonged dissection in inflamed areas. Controlled spontaneously in post-operative period. No major vascular injuries occurred.
- **Bile Leak** - 3 cases. Open cholecystectomy 2, Fenestrating STC - 1. Two cases with minimal leaks closed spontaneously. One case OC was treated with ERCP and recovered.
- **Pain** - more in Open cholecystectomy than Lap STC requiring more analgesics and sedation.
- **Wound Infection** - More in OC than STC with 2/4 vs 2/8.
- **Hospital Stay** - More in OC than STC 12 days Vs 7 days. (average)

## 4. Discussion

Factors predisposing to BDI/VBI are related to anatomy, local pathology, difficulty in structural identification, and improper techniques. The most common mechanism of such injuries involves the misidentification of the common bile duct (CBD) or common hepatic duct (CHD) as the cystic duct or the misidentification of the hepatic artery as the cystic artery.<sup>[4]</sup> Lal and colleagues<sup>[9]</sup> suggest that a difficult cholecystectomy is one taking longer than 90 minutes, tearing of the gallbladder with spillage of gall stones, spending more than 20 minutes dissecting the gallbladder adhesions, or more than 20 minutes dissecting Calot's triangle. While time to dissect the Calot's triangle will vary on surgical skills and level of experience of the surgeon, it will generally be longer in difficult GB surgery. The surgeon must be aware of the Culture Of Safety in Cholecystectomy (COSIC). Principles of performing a safe LC include a good knowledge of surgical anatomy, pre-operative identification of risk factors of difficult cholecystectomy. The usage of correct technique that includes: correct exposure/display of hepatocystic (HC) triangle in preparation of dissection, keeping dissection in the safe zone above R4U line, cautious use of energy sources, achieving the Critical View of Safety

(CVS), recognising error traps, strategies to handle a difficult situation, stopping rules, second opinion/surgical assistance, use of intraoperative imaging to clarify the anatomy, Bail-out procedures, and documentation<sup>[4]</sup>. The critical view of safety (CVS), introduced by Strasberg et al. in 1995, is a secure method of ductal (anatomic) identification as a set of criteria that must be achieved before any ligation of ductal structures. These criteria include separation of the lower end of the gallbladder off of the liver to expose at least the lower third of the cystic plate, all fibrous and adipose tissues cleared within the hepatocystic triangle, two and only two structures are seen to enter the gallbladder<sup>[10]</sup>. The surgeon should know that he is in a risk zone when he is unable to obtain clear anatomy of the Calot's or hepatocystic triangle or when the dissection is troublesome due to bleeding, inflammation or fibrosis. Inflammatory adhesions in AC and fibrotic contraction of the hepatocystic triangle in Chronic cholecystitis cause adhesion of the gallbladder and cystic duct to the side of the common hepatic duct. This is the classical error of LC that causes BDI. Surgical decision making plays the most critical role in cases of the difficult gallbladder and the most challenging aspect of the surgery. When the fundus first technique of identification ductal system is used under these circumstances, a visual deception may result that the common bile duct is the cystic duct.<sup>[11]</sup> CVS is less susceptible to this deception because more exposure of ductal structures is needed to achieve CVS. If CVS is attained the anatomical structures are usually clear and LC can be safe. In these difficult GB cases, where the CVS cannot be reached, several important "bail-out" strategies such as subtotal cholecystectomy<sup>[8]</sup> can be employed, thus avoiding bile duct injury. CVS should not be seen in isolation, but as an element of an overall scheme of a "Culture of Safety in Cholecystectomy" in which other elements such as good bail-out techniques, good access techniques, and other elements of safety are also employed.<sup>[10]</sup> TG18 and SAGES STFC advocate bailout procedure in difficult GB surgery. Delphi consensus on BDI at TG18 and STFC also advise bail-out procedures in difficult GB surgery to avoid BDI.<sup>[12]</sup>

STC is a better option over OC with added advantages laparoscopic surgery. Conversion to OC does not guarantee completion of cholecystectomy but has increased chances of VBI and post-operative complications. Add to it the present generation of surgeons is not good at performing OC. Cholecystostomy with tube drainage provides symptomatic relief until an interval surgery can be performed. It can be performed laparoscopically or after conversion to an open procedure. It is important to remember that the interval LC may again be difficult, with a higher rate of conversion and morbidity. In Fundus first technique the gallbladder is dissected off its liver bed/cystic plate, and then the cystic duct and the artery are identified and divided. This technique is commonly used in open cholecystectomy. This technique poses technical challenges in laparoscopy handling the gallbladder as it tends to twist once separately completely from the liver. Additionally, there is difficulty in retracting liver. Using this technique in an uncomplicated cholecystectomy, the surgeon keeps the dissection close to the gallbladder, moving from the fundus towards the HC triangle. Dissection within the triangle then allows the

identification of both the cystic duct and the cystic artery. But in cases of chronic cholecystitis with a small shrunken gallbladder and a fused and scarred HC triangle secondary to severe inflammation the plane between the gallbladder and the cystic plate is obliterated. It is very difficult to ascertain whether the dissection is on or within the plate, the surgeon may get into the wrong plane while dissecting down towards the lower end of the cystic duct. There may also be a pathological shortening of the cystic plate so that the distance between the fundus (where the cystic plate starts) and the right portal pedicle (where the cystic plate ends) may decrease so much so that the surgeon may encounter the right portal pedicle or hilar area soon after the dissection begins with an extreme VBI.<sup>[7]</sup> Laparoscopic STC is a better alternative in difficult GB to avoid VBI. A systemic review and meta-analysis of large series of cases on subtotal cholecystectomy in difficult gall bladder by Elshaer and colleagues revealed laparoscopic subtotal cholecystectomy causes less morbidity and mortality than an open approach.<sup>[13]</sup> STC is an accepted safe alternative to total cholecystectomy. Leaving behind a part of the gallbladder is always safer than a difficult dissection in the HC triangle with a potential for BDI in an attempt to remove the entire gallbladder. Both methods of laparoscopic STC, fenestrating and reconstituting are safe and accepted procedures. Both have its advantages and disadvantages. Fenestrating STC has greater chances of biliary leak 42% vs 16.5% which needs endoscopic stenting in 10% of cases.<sup>[4]</sup> It is technically difficult to suture the cystic duct opening. Its advantage is it is not associated with recurrent cholecystolithiasis. Reconstituting STC is technically easier but has a remote chance of recurrence cholecystolithiasis. It has less chance of biliary leak. A meta-analysis of STC by Elshaer et al found no significant difference of complications in either method.<sup>[13]</sup> A large series by Palanivelu et al<sup>[14]</sup> in Laparoscopic cholecystectomy in patients with cirrhosis of Liver advise STC with leaving the posterior wall of GB on liver bed. This avoids major bleeding from the liver bed. Our experience with STC surgeons preferred more Reconstituting STC than Fenestrating due to fear of bile leak and technical difficulty. Early recognition of difficult GB and decision for bail-out procedures prevented major BDI. BDI were common in introductory phases of LC where conversion to OC was common. With expertise, laparoscopic STC is used more than conversion with better results.

## 5. Conclusions

This article describes a damage control approach in difficult cholecystectomy by using a laparoscopic subtotal cholecystectomy. A difficult cholecystectomy is a commonly encountered problem for every surgeon. Cholecystectomy is not just the removal of GB but also taking care in avoiding BDI. Complicated gallbladder disease necessitates careful planning and management of surgery. The use of surgical risk prediction scores and an objective establishment of the degree of difficulty for LCs are the foundations of correct surgical planning. The pre-operative assessment of difficult GB with intra operative staging of disease warns the surgeon for early recognition of the problem and to adopt safe bail-out procedures. Subtotal cholecystectomy is an accepted alternative procedure during

difficult gallbladder surgery. It should be considered early in the difficult surgery preferably before conversion to an open procedure. Vasculo-biliary injuries can be avoided and the immediate and long-term outcomes are acceptable. A safe sub total (95%) cholecystectomy is better than 100% total cholecystectomy with BDI.<sup>[10]</sup>

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