



Intraluminal Guided Retrograde Dissection Technique with Stenting of Cholecystocystic Stump in Difficult Gallbladders with Frozen Calot's Triangle to Avoid Subtotal Cholecystectomy- A Prospective Study

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ABSTRACT:

Laparoscopic cholecystectomy is considered as a gold standard in the management of gallstone disease and may be a straight forward procedure, done by antegrade dissection technique with creation of critical view of safety to identify the structures at calot's triangle clearly to avoid any bilio-vascular injury. In certain difficult gallbladders with frozen calot's triangle we may proceed with other alternative techniques e.g. fundus first, retrograde dissection technique and transection at body of GB with antegrade and retrograde dissection technique with total or subtotal cholecystectomy. But in certain challenging situation of difficult gallbladders with assimilated and dense adhesions due to recurrent inflammatory pathology, the anatomy at calot's triangle gets frozen and distorted and there may be impending risk of bilio-vascular injury if traditional antegrade dissection technique is followed, so in such situations to protect against these risks we can follow Innovative Technique of Intraluminal Guided Fundus first Retrograde Dissection Technique which is based on the principle that no anatomical structure passes through the lumen of the gallbladder and it is safe to proceed up to the level of cholecystocystic junction by intraluminal guided retrograde dissection technique and further dissection of residual GB stump by stenting it with the feeding tube which shows the orientation of cystic duct and common bile duct (CBD) and also facilitate the safe dissection below cholecystocystic junction and then dissected out cystic duct is either ligated or clipped and so converting subtotal to total cholecystectomy and avoiding all the complications associated with residual cholecystocystic stump. In this study we have done 87 patients with no CBD injury and also converted all subtotal cholecystectomies into total cholecystectomies except those in which we were unable to stent the residual GB stump. Other complications are comparable to routine laparoscopic cholecystectomies.

Key Words: Intraluminal Retrograde Fundus Dissection, Frozen Calot's Triangle, subtotal Cholecystectomy, Cholecystocystic stump stenting.

Introduction

The Almighty God has created the mankind among the living beings with the best brain faculties superior to one another in one aspect or another indicating that no one is absolute here and this all is to make them interdependent upon each other so as to create a well-connected useful social fabric so that they may use these individual special abilities to innovate the new ideas and concepts to bring out the new evolutionary skills and techniques which are then used for the solution of existing problems faced by human beings and thenceforth these are used for the benefit and survival of the mankind. Surgery is an everchanging art and the new heights that it has achieved today is only because of the innovative efforts and hard research work of the pioneer surgeons. Many new techniques and technical modifications are consistently being introduced to deal with the difficult and complex surgeries and to make these difficult surgeries and procedures easier for the surgeons as well as acceptable and satisfactory for the patients with smooth and early recovery, shorter hospital stay and low postoperative morbidity and mortality. Our endeavor here is to deal with the difficult gallbladders which by itself is a big challenge for the surgeons and when they are encountered with such perplexed situations, they need some way out which can be achieved only by some technical modifications in traditional techniques. As such we have a strong belief from our experience in dealing with these inflamed gallbladders, that every gallbladder by itself is a book which needs to be read time and again for a better management and outcome and as for as laparoscopic cholecystectomy is concerned it is universally accepted as a gold standard for the management of symptomatic gallstone disease¹, usually a straight forward procedure performed by antegrade dissection technique with the identification and meticulous dissection at calot's triangle to create critical view of safety² which is essential to avoid bilio-vascular injury but this technique may not be applicable in difficult gallbladder with severely distorted anatomy at calot's triangle³. As for as review of literature is concerned the difficult aspect to understand and to define is the word "difficult gallbladders"⁴. However, we believe that term difficult is a relative term and there are certain general principles and technical modifications that need to be followed before undertaking the laparoscopic cholecystectomy⁵. Even though this is an era of advanced laparoscopy and can manage these difficult gallbladders laparoscopically and certainly there are limitations as well, so we must have some modifications in the technique intraoperatively to succeed or must have a low threshold for conversion to open to avoid complications except if preplanned for open surgery depending upon the preoperative existing conditions and evaluation.^{6,7}

Cholecystectomy [lap./open] is a commonly performed procedure by general surgeons by established standard techniques but sometimes it becomes very difficult and full of risks when they are encountered with difficult gallbladders with frozen and distorted calot's triangle, with a complete visual road block due to recurrent chronic inflammatory process and assimilated adhesions, critical view of safety⁷ cannot be achieved by standard antegrade approach and if followed, it may lead to devastating bilio-vascular injury which may be a big tragedy for the patient and a shocking situation for the surgeon as well. The only safe and "damage control" option there is the subtotal cholecystectomy which is defined as leaving behind any portion of the gallbladder other than cystic duct⁸. The option of subtotal cholecystectomy whether open or laparoscopic depending upon the prevailing situation as a bail out technique and timing of decision making is crucial to avoid catastrophic bilio-vascular injuries^{9,10,11}. As difficult laparoscopy has 3-5 times more risk of BDI than the open cholecystectomy¹², the experience and modifications of techniques are crucial for the safe outcome. There is an increase trend in the use of these techniques that reflects their growing general acceptance to reduce the morbidity and complications of difficult gallbladders, especially common bile duct injuries¹³. Open subtotal cholecystectomy was first described by Hans Kehr in 1898 and laparoscopic subtotal cholecystectomy has been in practice since 1993. Subtotal cholecystectomy is a justifiable bail out procedure in case of difficult gallbladders with frozen calot's triangle where due to distorted anatomy critical view of safety cannot be achieved and have a high risk of bile duct injury if inadvertent traditional antegrade dissection technique is attempted. Asher Hirshberg stated that it is better to remove 95 % gallbladder than 101% i.e. with a piece of CBD¹⁴. Moreover surgeon should remember that there is only one CBD in human being which needs protection at any cost. Due to recurrent chronic inflammatory pathology and assimilated

dense adhesions the anatomy at Calot's triangle gets completely blinded so in this situation it is prudent not to proceed with the traditional approach but some alternative technique which may give guarantee that there will be no injury to the bile duct. The best technique to follow here is "the Intraluminal Guided Retrograde Dissection Technique" which is a situation proved best bail out technique when there is completely distorted anatomy due to recurrent inflammatory pathological process making traditional techniques impossible with high risk of devastating bilio-vascular injuries. This technique is based on the basic principle that no anatomical structure passes through the lumen of the gallbladder and one can proceed safely up to cholecystocystic junction by intraluminal guided retrograde dissection technique without exceeding the natural set anatomical limits as well as this is the only possible way to avoid the complications of residual cholecystocystic stump after subtotal cholecystectomy which may be reconstituting or fenestrating type¹⁵. As we know most of the complications associated with subtotal cholecystectomy are due to residual lumen of the gallbladder¹⁶ which is completely abolished by this technique and if we go one step beyond, we can stent CS Stump and further dissect out this stump to an extent which is sufficient enough to be ligated or clipped so as to make the subtotal cholecystectomy into complete cholecystectomy which is possible only by this technique.

MATERIALS AND METHODS:

This study comprises of patients operated in Department of Surgery, GMC, Jammu, J and K, India, over a period of three years w.e.f. Jan. 2019 to Jan.2021 and further follow up of six months. A total of 87 patients of difficult gallbladders are included in the study. All the patients of difficult gallbladders are included in the study which have intraoperative findings of frozen Calot's triangle with distorted anatomy and are not manageable by other traditional techniques which may be associated with high risk of bilio-vascular injuries and all other gallbladders manageable by other alternative techniques are excluded from the study. All the patients of difficult gallbladders are managed by laparoscopic, laparoscopic converted to open and open cholecystectomy, depending upon the severity of distortion by underlying inflammatory pathology or existing condition.

Details of Data Recorded includes: Demographic details, history of the patients, clinical findings and severity, CBC, liver function tests, renal function tests, radiological finding, timing of cholecystectomy, duration of surgical procedure, conversion rate, complication rate, mortality rate, length of hospital stay, any other relevant investigation and follow up.

METHODS:

The laparoscopic cholecystectomy has been carried out under general anesthesia with patient positioned supine. All patient received routine prophylactic antibiotics as per our institute's surgical site infection prevention protocol. The position of the four ports are as for standard laparoscopic cholecystectomy. These are positioned at the umbilicus(10mm), subxiphoid (10mm) and two below the right subcostal region 5 mm each at midclavicular and midaxillary line. Pneumoperitoneum created. Initial diagnostic laparoscopy was done to confirm the findings and intraoperative decision were to made to proceed conventionally or with our innovative technique "INTRALUMINAL GUIDED RETROGRADE DISSECTION TECHNIQUE FROM THE FUNDUS". This technique was applied when there was frozen Calot's triangle with distorted anatomy due to assimilated unyielding dense adhesions with no way out and impending risk of injury to bilio-vascular structures.

TECHNIQUE:

This technique is reserved for difficult gallbladders with frozen calot's triangle due to recurrent inflammatory pathology and consequent dense adhesions and distorted anatomy with complete visual road block where it is impossible to proceed with the conventional techniques.

Step 1. After preliminary diagnostic laparoscopy adhesiolysis of gallbladder with adjacent structures is done.
 Step 2. Fundus of gallbladder is fixed and with the help of an aspiration needle suction and evacuation of its contents is done to avoid spillage during the procedure.

Step 3. With the help of hook attached with the cautery a hole is made near the fundus and whole contents of gallbladder are evacuated and lumen of the gallbladder is cleaned with normal saline by irrigation and suction.

Step 4. Incision is extended with cautery from fundus to just above the cholecystocystic junction.

Step 5. Starting with the counter traction of liver and gallbladder intraluminal guided retrograde dissection is started from fundus downward, just above the cholecystocystic junction with the basic principle that no structure passes through the luminal of gallbladder and is safe to proceed up to this level.

Step 6. Now residual GB stump is stented with either guide wire or infant feeding tube to assess the orientation, extent and direction of CD and CBD to facilitate the further safe dissection of CS stump of sufficient length to ligate or clip it.

Step 7. In certain situations, like empyema gallbladder or any other condition causing obliteration of the cystic duct and confirmation of no bile from it, stenting and further dissection of GB stump is not attempted and after fulguration left as such without clipping or ligating and in case of cirrhotic liver posterior wall is left intact after mucosectomy or fulguration.

Step 8. Postoperatively copious saline wash and irrigation is done, and all saline is sucked out and a white gauze piece is taken and placed on bed for 3- 5 minutes to see any bile staining to rule out any biliary leak.

Step 9. Gallbladder is bagged and retrieved.

Step 10. Subhepatic drain is placed in every case of this study and usually removed after 24-48 hours.

RESULT:

This study is conducted in the Department of surgery in GMC Jammu, J and K, India w.e.f. Jan. 2019 to Jan. 2021 with further follow up for six months. All the gallbladders which are not manageable by other alternate techniques are included in this study. It is based on intraoperative findings of frozen calot's triangle with distorted anatomy due to assimilated adhesions and complete blinding of the field and only option left is to convert but by this technique we can proceed safely to complete the procedure. A total of 87 patients were operated by this Intraluminal Guided Retrograde Dissection Technique. Among these, 48 patients were male, and 39 patients were females. Age group varies from 41-76 years. Majority of the patients were above 57 years. 31 patients were from low socioeconomic status, rest are lower middle and middle class. 37 patients are from far off places with minimal medical facilities. Most of these patients have a long history of symptoms of recurrent attacks of acute cholecystitis (67 patients). 5 patients had history of upper abdominal surgeries, two patients with duodenal ulcer (DU) perforation, one had hydatid liver surgery and one patient operated for liver abscess. 67 patients had associated comorbid conditions. 28 patients were ASA-1 and 59 patients ASA -2, none were ASA-3 and ASA-4. All patients were comparable in demographic data, clinical, laboratory and imaging parameters.

	Total patients	87	
	Age	41-76	58.5 +/-17.5
	Male/Female	48/39	55.17/44.82%
	Backward areas	37	42.52%
	Below poverty lines	31	35.6%
	Recurrent cholecystitis	67	77.01%
	Co-morbidity	61	72.41%
	hypertension	32	36.78%
	Diabetes	23	26.43%
	Hypothyroidism	9	10.34%
	COPD	17	19.54%
	Upper abdomen surgery	5	5.74%
	Lower abdomen surgery	17	19.54%
	ASA-1	28	32.18%
	ASA-2	59	67.81%

Table1: Patient Characteristics.

1	Hemoglobin	7.6-11.8(9.7+2.1)mg/dl
2	White blood cell count	5.2-13.9(9.5+ 4.4)
3	Platelets count	135-250(192.5+ 57.5)
4	Blood urea	27-54(40.5-13.5)
5	Blood creatinine	0.7-2.1(1.4+ 0.7)
6	Serum bilirubin	0.2-1.81(1+ 0.8)
7	Serum alkaline phosphatase	164-192(178+ 14)
8	SGOT	28-56(42+ 14)IU/L
9	SGPT	13-45(29+ 16)IU/L
10	Total protein	6.2-8.1(7.15+ 0.95)gm/dl.
11	Serum Albumin	2.5-4.5(3.5+ 1)mg/dl.
12	Serum Amylase	45-86(65.5+ 20-5)
13	PTI	84-98(91+ 7)

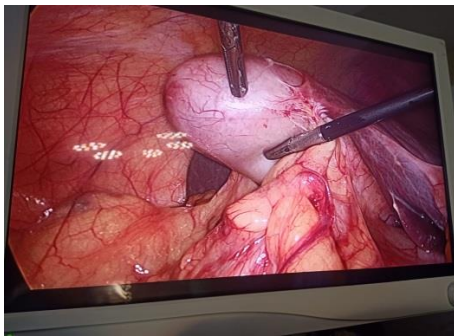
Table 2. Laboratory Data

1.	Frozen calot's triangle with distorted billion-vascular anatomy.	87
2.	Dense adhesions with surrounding structure.	13(14.94%)
3.	Perforated gallbladders.	0 7 (8.04%)
4.	Inflamed thick-walled GB.	12(15.79%)
5.	Gangrenous GB.	0 4(4.59%)
6.	Empyema GB.	07(8.04%)
7.	Mirrizi's syndrome type 1and 2.	02(2.29%)
8.	Cholecystoduodenal fistula	02(2.29%)
9.	Fibrosed, contracted GB.	23(26.43%)
10.	Chronic cholecystitis with liver cirrhosis.	05(5.74%)
11.	Chronic cholecystitis with giant stones >4cm.	03(3.44%)
12.	Small fibrosed contracted GB.	04(4.59%)
13.	Xanthogranulomatous cholecystitis.	01(1.14%)
14.	Mucocele of GB.	03(3.44%)
15.	Complete intrahepatic GB.	01(1.14%)

Table3.Intraoperative Findings

1	Laparoscopic cholecystectomy	59(67.81%)
2.	Converted to open cholecystectomy	11((12.64%)
3.	Open cholecystectomy	17(19.54%)
4	Successful stenting of GB stump	69(79.31%)
5.	Failure of cholecystocystic stump stenting	18(20.68%)
6	Operation time.	45-90min.(67.5+ _22.5)
7	Hospital stay	2-5 days(3.5+_1.5)
8.	Return to normal activities	7-15 days
9	Complications	27(31.03%)
10.	Port site infection/surgical site infections	11(12.64%)
11	Biliary leaks	5(5.74%)
12	Bile duct injuries	0(0%)
13	Systemic complications	11(12.64%)
14	Mortality	2(2.29%)

Table 4. SURGICAL OUTCOME.



Acute cholecystitis



Stenting of cholecystocystic stump with feeding tube.



Empyema gallbladder with frozen calot.

Analysis of Surgical Outcome:

All the eighty-seven patients in this study were having intraoperative findings of frozen calot's triangle with distorted bilio-vascular anatomy due to long chronic and recurrent inflammatory pathology and assimilated adhesions with no way out and associated other findings as shown in table no. 3. The seven patients admitted through emergency had preoperative diagnosis of gallbladder perforation and underwent open cholecystectomy with intraluminal guided approach with GB stump stenting for complete cholecystectomy. 59 Patients underwent laparoscopic cholecystectomy, 11 patients were converted to open cholecystectomy for different reasons and 17 patients have preoperative plan for open cholecystectomy and underwent the same. In all these patients we were able to do subtotal cholecystectomy. In 69 patients out of 87 patients, we were able to stent residual GB stump and converted subtotal cholecystectomy to complete cholecystectomy. In rest of 18 patients, we were unable to cannulate the CS Stump due to obliteration of cystic duct by inflammatory pathology but were able to fulgurate the mucosa. After completing the procedure, placed a white gauze piece in GB bed and wait for 3-5 minutes to rule out bile leak and if no evidence of bile leak, no further intervention is required just placed the drain and come out. Trans fixation or clipping of stump is done in every case except 3 patients of empyema GB with obliterated cystic duct. Operation time ranges from 45-90 minutes (67.53 ± 22.55), Hospital stay 2-5 days (3.5 ± 1.5), Return to normal activities within 7-15 days (11 ± 4). 11 patients are converted to open cholecystectomy due to dense adhesions of gallbladder with liver and one patient having xanthogranulomatous cholecystitis with adherent omentum and transverse colon. One patient had cholecystoduodenal fistula. 7 patients had preoperative diagnosis of gallbladder perforation, and all were done by open technique. Rest of the patients were done by laparoscopic intraluminal guided retrograde dissection technique followed by GB stump stenting and completing the cholecystectomy. In 23 patients, we had complications detailed in table 11. Patients had port site infection which were due to retrieval of infected gallbladders, and settled within 5-7 days, among these two had atypical mycobacterial infection which appeared after four weeks and were not settling, biopsy confirmed the diagnosis and put on appropriate treatment and settled. 5 patients had biliary leaks, three from GB bed and two, due to dislodge of clips from cystic duct due to missed CBD stones. ERCP clearance of CBD and stenting done in 2 patients, rest settled within few days. No patient has bile duct injury. The 11 (12.64%) patients have systemic complications, among these 9 patients settled with antibiotics and supportive treatment and 2 (2.29) patients succumb to systemic complications (most of these patients were elderly with associated comorbidities). Postoperative recovery was smooth and uneventful in most of other patients. Most of these patients remain in our follow up for 4-6 months with 18.39% minor complications like port site infections, biliary leak from GB bed, two patients needed ERCP, and no long-term complication seen. This is very effective and safe technique in the management of difficult gallbladders.

DISCUSSION:

Laparoscopic cholecystectomy is a commonly performed surgical procedure by general surgeons and is considered as a gold standard¹⁷ and is technically a straightforward procedure in the management of cholelithiasis, usually undertaken by antegrade dissection technique with creation of critical view of safety at calot, triangle¹⁸ and also sometimes by retrograde dissection technique in difficult calot. But in difficult gallbladders with frozen and distorted calot's triangle, it is impossible to proceed with this as well as other alternative techniques which may risk the misidentification and inadvertent bilio-vascular injuries and this is the most challenging situation for most of the surgeons with complete anatomical distortion and blinding of calot's due to dense and assimilated adhesions so any attempt by standard technique is practically unsafe and may be associated with severe bilio-vascular injuries, prudent here is not to collide with the danger zone but to circumambulate it safely. The only bail out technique, which is safe, effective and time proven in such situation is intraluminal guided retrograde dissection technique which is based upon the basic principle that no structure passes through the lumen of the gallbladder, and you can dissect safely up to cholecystocystic junction by this innovative technique without any possibility of bilio-vascular injuries. It is also worth to mention here that any structure going or leaving to gallbladder is safe to ligate and cut but any structure not

going to GB should not be ligated or cut (as there is only one common bile duct in humans). There is no consensus among the surgeons which technique should be adopted in such challenging situation, but all depend upon the personal expertise of the surgeons. In any operative procedure the basic gold principle is to keep oneself on the safe side underdone is better than overdone and always remember safety saves and a good navigator is one who knows the tricks of saving himself from the tides of misfortune. The risk is always an inherent part of surgical play and cannot be avoided but can be meticulously dealt with if anticipated in time and surgeon should know if he has an available experience and required equipment to deal with the presenting complications. In various studies in literature the management of difficult gallbladders with frozen calot, the subtotal cholecystectomy is considered as a safe bail out procedure even though there are certain reservations with residual GB stump which may have associated with it some early and late complications, and which may need some type of reintervention at some point of time not acceptable by patients. The incidence of difficult gallbladders reported in literature is 10-15% of the total cases of acute cholecystitis¹⁹. There are various methods and techniques mentioned in the literatures for safe surgery in the difficult gallbladders to avoid iatrogenic bilio-vascular injuries e.g. obtaining critical view of safety²⁰, identifying Rouvier's Sulcus²¹, intraoperative cholangiogram²², the intraoperative fluorescent cholangiogram using indocyanine green iv 30 min. before the surgical procedure allows the fluorescent images of the biliary system to be obtained²³ inside approach alternative to conventional one²⁴ and lastly to convert to open procedure^{6,7}. According to Tokyo Guidelines 2018, the severity of acute cholecystitis correlates with an increased risk of bile duct injuries²⁵. The bile duct injury is the most devastating and unforgivable thing for the patient which leads to increased hospital stay, morbidity, mortality rate and may require additional interventions including liver resections and other modalities of management. So, to avoid this one may need some innovative technique which does not directly challenge the hostile calot but instead take the alternate route. There are certain innovative techniques which are adopted in difficult gallbladders with frozen calot's triangle as a bail out procedure with total or subtotal cholecystectomies prospective to severity of underlying pathology at calot e.g. fundus first retrograde dissection technique with subtotal or total cholecystectomy, transection at body with antegrade and retrograde dissection technique with total or subtotal cholecystectomy. In our study of difficult gallbladders with severely distorted anatomy, we apply intraluminal guided retrograde dissection technique with subtotal cholecystectomy followed by stenting of cholecystocystic stump and safely completing the cholecystectomy (whether lap, lap. Converted open or open cholecystectomy d/u intraoperative findings) which is based on the basic concept that no anatomical structure passes through the lumen of gallbladder and retrograde dissection up to cholecystocystic junction is safe, effective and time proven bailout procedure if strictly done under intraluminal guidance in stepwise manner and have a promising result in this era of no forgiveness. Ultimately it is the experience of operating surgeon which matters whatever technique one might use. But undeniable reality is that complications are inherited part of surgical play and will continue to happen irrespective of any innovative technique whatsoever it may be.

CONCLUSIONS

1. The intraluminal guided retrograde dissection technique with stenting of cholecystocystic stump is a very effective, precise and a safe technique of dissection in difficult gallbladders with frozen and severely distorted anatomy at calot's triangle and a viable solution to prevent bilio-vascular injury and culminating subtotal to total laparoscopic cholecystectomy.
2. This technique also work effectively with same principles if applied in open cholecystectomy.
3. Biliary and vascular injuries can be avoided with certainty if done meticulously.
4. Conversion rate can be lower down significantly.
5. Subtotal cholecystectomy which is usually associated with difficult gallbladders as a bail out procedure can be converted to complete by stenting of GB stump with feeding tube by this technique.
6. It is not a difficult technique to master if anybody knows intra corporeal knotting and suturing and it is also less time consuming compared to other technique.
7. Always remember that there is a variability in experience and skill of different surgeons, so no technique is comparable to experience.

8. The intrinsic errors are inherited in surgical techniques and cannot be avoided and whenever these happens open approach should always be given preference.

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