

How to manage a dilated cystic duct during laparoscopic cholecystectomy?

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Back

ground Closure of the cystic duct (CD) is a must during laparoscopic cholecystectomy (LC). Metal clips were the standard technique used before. Now there are different methods used to occlude the CD (endoloop, suturing with absorbable materials, and endo-GIA stapling devices).

Aim

To assess different methods used in closure of dilated CD during laparoscopic cholecystectomy.

Patients and methods

This was a retrospective study done on 169 patients with difficult cholecystectomies of 3645 patients who had laparoscopic cholecystectomy in the General Surgery Department, Zagazig University Hospitals, in the period from January 2011 till March 2020.

Results

A total of 169 patients were included, comprising 98 females and 71 males, with an average age of 45 ± 17.2 years. All patients had dilated CD during laparoscopic cholecystectomy that was occluded by different methods: large metal clips in 39 patients, ligature in 43 patients, endoloop in 33 patients, suturing to close the CD orifice in 30 patients, and endo-GIA devices in 24 patients.

Conclusion

We should keep in mind different methods when facing dilated CD during laparoscopic cholecystectomy according to its diameter and the availability of equipment.

Keywords:

dilated cystic duct, endoloop and metal clips, laparoscopic cholecystectomy, ligature, suturing

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Introduction

Cholecystectomy comes in the second place after appendectomy regarding commonly performed intraabdominal operations worldwide [1]. Laparoscopic cholecystectomy is the gold standard procedure in the treatment of symptomatic gallstones [2]. In laparoscopic cholecystectomy, occluding the cystic duct (CD) permanently is a classic step [3]. The use of metal clips in ligation of the CD is the commonly used procedure [4].

Sometimes, the surgeons face some difficult situations during the performance of a laparoscopic cholecystectomy. This includes anatomic anomalies, such as short CD or a sessile gallbladder (GB), and pathologic problems, such as Mirizzi syndrome, GB empyema, or a frozen Calot's triangle secondary to infection and fibrosis [5].

Moreover, the problem is in the CD itself, such as facing inflammation, edema, or fibrosis in the CD, or facing an extremely large CD, which is difficult to be managed safely and easily especially if there is

a stone in the CD. Accordingly, several methods have been suggested to ligate the CD, including absorbable endoclip, endoloop, large titanium endoclip, intracorporeal or extracorporeal tie with absorbable or nonabsorbable material, endo-GIA staplers, ultrasonic coagulating shears, or electrothermal bipolar sealer [6–10].

In our study, we assessed the different methods of dilated CD closure during laparoscopic cholecystectomy.

Patients and methods

A total of 3645 patients had laparoscopic cholecystectomy in a retrospective study in the period from January 2011 till March 2020. The study held in general surgery department, Zagazig

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University hospitals. after patient consent and ethical committee acceptance. Of them, 169 patients had difficult cholecystectomies with dilated CDs. The study was held in General Surgery Department, Zagazig University hospitals.

All data for these patients were recorded (demographic data, associated comorbidity, operative data, operative time, postoperative complications, and follow-up). Laboratory investigations (CBC, LFTs, KFTs, and bleeding profile) and abdominal ultrasound were done for all patients.

We used endoscopic retrograde cholangiopancreatography (ERCP) in patients with choledo-cholithiasis, whereas magnetic resonance cholangiopancreatography (MRCP) and multi-slice computed tomography were used when indicated (to delineate the biliary anatomy in patients with acute cholecystitis and Mirizzi syndrome, or to detect sub-hepatic collections).

Surgical technique

Laparoscopic cholecystectomy and intraoperative cholangiogram were done for cases, which revealed CD stones or intraoperative dilated CD.

We usually when facing such cases do the following:

- (1) Critical view of safety.
- (2) Minimal use of electrocautery in Calot's triangle.
- (3) Using 30° telescope (if we start with 0°).
- (4) Aspiration of the acutely inflamed gallbladder to facilitate its handling.
- (5) Careful and meticulous dissection around Calot's triangle with respect to the anatomy not to miss anatomical variations.

Closure of the CD was done depending on its status:

- (1) Impacted CD stones: anterolateral incision, and a partially closed Maryland was used to milk the CD. Cholangiogram was done using a 6-F ureteric catheter. If common bile duct (CBD) stones were identified, ERCP was used for extraction or using balloon catheter or dormia basket extraction through the dilated CD laparoscopically.
- (2) Dilated CD more than 0.5 cm: we used large polymer clips.
- (3) Dilated CD reaching 1 cm or more: absorbable suture 2/0 vicryl used to ligate the CD or via endoloop.
- (4) Dilated CD and friable: separation of the CD from the gallbladder and suturing its orifice using absorbable suture 2/0 vicryl.

- (5) Dilated CD from 1.5 to 2 cm: endo-GIA reticular stapler with 4.8-mm (green) or 3.5-mm (blue) cartilages used according to the tissue thickness (the endo-GIA must be behind the CD, and the locking mechanism should be free of any intervening tissue before firing) (Fig. 1).

We usually depend on preoperative ultrasound dimensions of the CD.

Results

During the study period, 3645 patients had laparoscopic cholecystectomy. The rate of conversion to open cholecystectomy was 0.8% (29 patients). The causes of conversion were as follows:

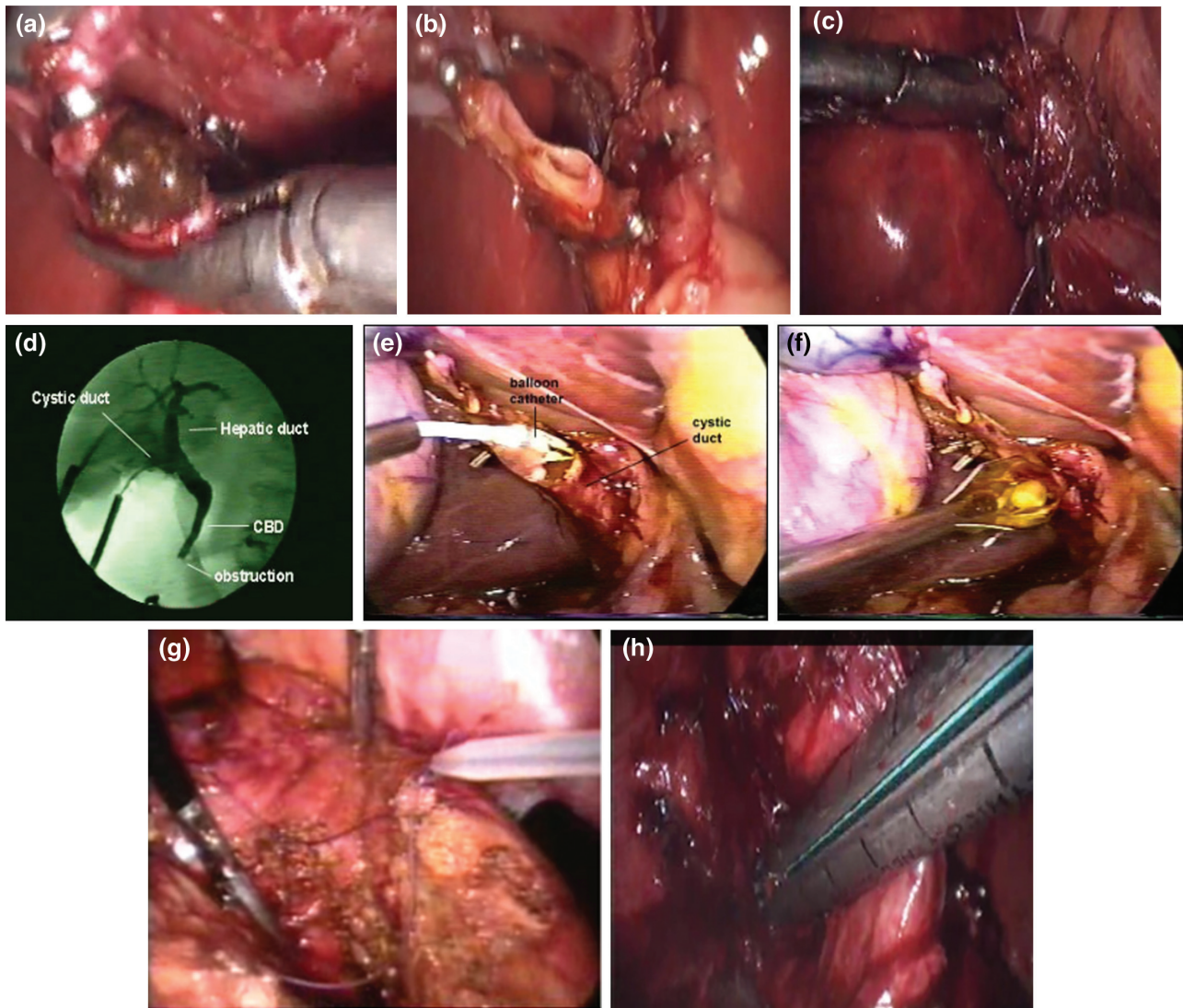
- (1) Intraoperative bleeding in nine patients owing to avulsed cystic artery.
- (2) CBD injury in 12 patients.
 - (a) Side wall injury in four patients managed with primary closure over CBD stent.
 - (b) Complete CBD injury at the level of CHD in eight patients managed with Roux-en-Y hepatico-jejunostomy.
- (3) The last eight patients were converted to open owing to frozen Calot's triangle.

Our study was done on 169 (4.636%) patients, comprising 98 (57.99%) females and 71 (42.01%) males, with average an age of 45±17.2 years (31–69 years). A total of 56 (33.14%) patients had comorbidities (29 patients were diabetics, 31 patients had morbid obesity, and 26 patients had liver cirrhosis). Most of our patients [59 (34.91%)] had chronic calculous cholecystitis without CBD stones.

Large metallic clips were used in 39 (23.07%) patients with dilated CD more than 0.5 cm. Ligature of the CD and endoloop with absorbable material (2/0 vicryl) were used in 43 (25.44%) and 33 (19.53%) patients with dilated CD more than 1 cm. Impacted CD stones were presented in 21/43 (48.84%) and 13/33 (39.39%) patients. Intraoperative cholangiogram was done for these patients, revealing CBD stones. In ligature group, nine of them had CBD stones (ERCP in three patients and in the other six patients balloon catheter and dormia basket used for stone extraction). Moreover, CBD stones were found in seven patients of endoloop group extracted by intraoperative ERCP.

Suturing of the CD orifice was done in 30 (17.75%) patients with acute cholecystitis accompanied with friable and edematous CD more than 1.5 cm. In this group, CBD stones were found in six patients, and

Figure 1



(a) Cystic duct stone. (b) Stone extraction with large metal clips. (c) Absorbable ligature for cystic duct closure. (d) Intraoperative cholangiography. (e) Stone extraction with balloon catheter. (f) Stone extraction with dormia basket. (g) Endoloop used for cystic duct closure. (h) Stapling device used for cystic duct closure.

Table 1 Different modalities of cystic duct closure during laparoscopic cholecystectomy

Cystic duct closure	Number of patients (169) [n (%)]	Operative time (67 ±38.3 min)	Intraoperative cholangiogram [53 (31.36%)] [n/N (%)]	Cystic duct diameter (cm)	Hospital stay (2.3 ±1.7 days)
Large clip	39 (23.07)	31±10		0.5–0.7	1–2
Ligature	43 (25.44)	96±16	21/53 (39.62)	1–1.5	2–3
Endoloop	33 (19.53)	69±13	13/53 (24.53)	1–1.5	2–3
Suturing	30 (17.75)	158±23	19/53 (35.85)	1.5–2	5–7
Endo-GIA	24 (14.21)	131±27		1.5–2.2	3–5

extracted by dormia basket and balloon catheters laparoscopically was done. Finally, we used endo-GIA stapling devices in 24 patients with dilated CD from 1.5 to 2.2 cm (Table 1).

Regarding postoperative complications, we faced 19 (11.24%) patients with morbidities, with no mortality. Obstructive jaundice occurred in eight patients; two

resolved spontaneously and the other six managed with ERCP and stent. In suturing group, three patients had biliary leak. MRCP revealed leakage from the CD stump, which was managed via ERCP and stent. Port site wound infection occurred in four patients. Lastly, incidental gallbladder cancer was found in four patients. For them, liver resection of segment IVb and segment V with porta-hepatis lymphadenectomy and

excision of the epigastric port site were done to prevent port site metastases.

Discussion

For over two decades, laparoscopic cholecystectomy was considered as a gold standard. Surgeons should always keep in their mind its different pathology and varied clinical presentation [11]. Being an expert or beginner, surgeons revere gallbladder surgery [3].

In acute cholecystitis, laparoscopic cholecystectomy is a safe procedure done in the 'golden 72 h' from symptoms onset [12]. 'Cool down' means postponing patients with acute attacks for weeks (around 4 weeks) by giving them medical treatment, with failure rate up to 20% regarding their response to treatment. Frozen Calot's is the nightmare faced by surgeons during 'cool down' period [13]. So laparoscopic subtotal cholecystectomy could be a feasible option for these difficult cases [5,14]. Laparoscopic cholecystectomy was done for 45 patients with acute cholecystitis and subtotal cholecystectomy in 18 patients with suturing closure of the CD, in our series.

The normal diameter of the CD ranged from 1 to 5 mm [15]. Dealing with CD stones may be through simply opening the duct to deliver it outside, or making incision in the duct to remove impacted stones [16]. We used intraoperative cholangiogram technique in 53 suspicious patients, where we found CBD stones in 22 patients (stones extracted by ERCP in 10 patients and via laparoscopy using balloon catheter or dormia basket in 12 patients).

Odabasi *et al.* [7] stated that there are different methods proposed for ligating the CD during LC, such as titanium or absorbable endoclip, an endoloop, a tie, an ultrasonic or bipolar sealer, and the endo-GIA stapler.

Either absorbable or nonabsorbable clips and knots could be made. Although it could be easy to use multiple clips, it is still not safe for a dilated and difficult CD more than or equal to 1 cm. Complications of using multiple clips are more with metallic ones. Brooks *et al.* [17] reported nine bile leaks among 650 patients in LC; three (0.46%) of them sure happened owing to clip dysfunction.

Simple ligature of the CD stump is a very safe technique, owing to avoidance of postoperative bile leak. Apparently, intracorporeal knot is a time-consuming way to close the CD, for beginners. However, on the

long run, it is a very corocious step in advanced laparoscopy [18]. Golash [19] performed 'C' technique intracorporeal knotting in 1000 patients and stated that it is easy, secure, and economical. In our study, ligature of CD was done in 43 patients, and postoperative obstructive jaundice owing to migration of gallbladder stones to CBD occurred in two patients only.

Another technique is endoloop, but for applying it, surgeon should divide the CD and then apply the endoloop. If the CD is separated from the GB, it is difficult to ligate it because CD stump can retract. So to avoid this, fundus first technique could be used [7].

In cases of acute cholecystitis, usually there was inflamed GB wall. So when suturing the CD opening, the incidence of bile leakage is high [20]. In our study, bile leakage occurred in three patients who were successfully treated by endoscopic biliary stenting. These results match with Matsumura *et al.* [11], which emphasize that bile leakage from the CD stump does not result in major complications when it can be controlled by conservative management. Recently, closure of the CD could be done using laparoscopic stapling devices, which is considered as a safe and feasible method for CD closure. The endo-GIA is safe and easy to use. Some precautions should be kept in mind before stapling, such as CD anatomy should be clear, adequate space should be left before firing the stapler device, and adequate length of CD stump to avoid injury of CBD [6]. Another issue is that there might be a CD stone which may fall into the CBD, so retraction is important, and before applying an endo-GIA, the CD should be squeezed toward the gallbladder to prevent crushing a CD stone [21].

Incidental gallbladder cancer is reported to be found during laparoscopic cholecystectomy, at a rate of 0.7% [22]. In our study, four patients had incidental gallbladder cancer, who were managed with liver resection and porta-hepatis lymphadenectomy.

Conclusion

Dealing with dilated CD during laparoscopic cholecystectomy could be done via different procedures. Large metallic clips, ligature, endoloop, suturing and endo-GIA staplers, all procedures could be chosen. All were effective and used in selected patients according to the CD diameter and CD status (inflammation and fibrosis).

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Conflicts of interest

There are no conflicts of interest.

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