



Use of Stapling Devices for Safe Cholecystectomy in Acute Cholecystitis

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Many techniques are described for the ligation of a difficult cystic duct (CD). The aim of this study is to assess the effectiveness and safety of stapling of a difficult CD in acute cholecystitis using Endo-GIA. From January 2008 to June 2012, 1441 patients with cholelithiasis underwent laparoscopic cholecystectomy (LC) at the Department of General Surgery, Haydarpasa Numune Education and Research Hospital. Of these, 19 (0.62%) were identified as having a difficult CD and were ligated using an Endo-GIA stapler. All patients were successfully treated with a laparoscopic approach. The length of hospital stay was 3.4 days. There were umbilical wound infections in 4 patients (21%). The length of follow-up ranged from 1.0 to 50.4 months. In conclusion, Endo-GIA is a safe and easy treatment method for patients with a dilated and difficult CD. The cystic artery should be isolated and ligated if possible before firing the Endo-GIA stapler. If isolation and stapling are not possible, fibrin sealant can be applied to avoid bleeding. The vascular Endo-GIA can be applied in a large CD, but for acute cholecystitis with an edematous CD, the Endo-GIA roticator 4.8 or 3.5 stapler is preferred.

Key words: Cholecystectomy – Endo-GIA – Acute cholecystitis – Stapler

After the introduction of laparoscopic cholecystectomy (LC) in 1987,¹ LC replaced open cholecystectomy as the gold standard for the treatment of cholelithiasis in international guidelines.² LC was initially considered to be contraindicated for

acute gallbladder inflammation, but it is currently a common procedure for acute cholecystitis.

Some of the difficult situations a surgeon is likely to face during the performance of a laparoscopic cholecystectomy include anatomic anomalies such

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as a sessile gallbladder or short cystic duct and pathologic entities such as an empyema, Mirizzi syndrome, or a frozen Calot's triangle secondary to infection and fibrosis.³

It is suggested that laparoscopic surgery should be carried out within 72 hours from the onset of the symptoms because after that time there are higher rates of conversion to open procedures, increased risks of complications, and longer operative times.⁴⁻⁶ The generally accepted procedure in patients whose symptoms started 72 hours before admission is to "cool down" the patient with appropriate medical therapy and to perform LC after a period of 6 to 12 weeks.^{7,8} This approach aims to avoid a potentially more difficult cholecystectomy during an emergency admission and to avoid the difficulties of access to an emergency room.^{9,10} However, more than 20% of patients may fail to respond to conservative treatment and require an urgent and rather more difficult cholecystectomy, and a further 25% of patients will require readmission with a severe acute complication of cholelithiasis while awaiting a cholecystectomy.^{11,12} The scar formation, distortion, and organized adhesions around the gallbladder occurring secondary to the chronic inflammation in Calot's triangle make the dissection difficult. The cystic duct (CD) is sometimes edematous, fibrous, or enlarged owing to inflammation and adhesions in acute cholecystitis and may be difficult to manage. Several methods were proposed for ligating the CD, including titanium or absorbable endoclip, endoloop, tie, ultrasonic or bipolar sealer, and the Endo-GIA stapler (Covidien, Mansfield, Massachusetts).¹³⁻¹⁹

This study proposes an effective, safe, and easy procedure for the stapling of dilated or difficult CD using the Endo-GIA.

Materials and Methods

From January 2008 to June 2012, 1441 patients with cholelithiasis underwent LC at the Department of General Surgery, Haydarpasa Numune Education and Research Hospital. The generally accepted procedure in patients whose symptoms started 3 or 4 days before admission is to "cool down" the patient with appropriate medical therapy. However, 19 patients failed to respond to conservative treatment, and the clinical signs persisted or worsened; so they required an urgent LC. They were identified as having a difficult CD. A retrospective review was carried out to identify patients in whom stapling devices were used. The collected



Fig. 1 Application of Endo-GIA roticulator 45-4.8 for acute cholecystitis.

data included the patient age, sex, preoperative diagnosis, morbidity, and management. In addition to the history and physical examination, ultrasonography (US), endosonography (EUS), endoscopic retrograde cholangiopancreatography (ERCP), computed tomography (CT), or magnetic resonance cholangiopancreatography (MRCP) were performed for diagnosis. Patients with common bile duct (CBD) stones had the stones removed by ERCP before LC.

Four of the authors participated in the study. The decision to use a stapling device for cholecystectomy was always made intraoperatively when it was determined that further dissection would expose the patient to a higher risk of common bile duct injury.

The surgery was performed under general anesthesia using a standard 4-trocar technique. Completing the posterior dissection first is a cardinal principle in our department. After skeletonizing the cystic artery and duct, a medium large titanium clip was used to ligate the duct and artery. When only the cystic duct was dilated and the anatomy was clear, we used large polymer clips or nonabsorbable suture for ligation with a knot pusher. The CD and cystic artery were identified, and if possible the artery was ligated first using titanium clips. The dilated CD was cleaned, and sufficient space existed to apply the Endo-GIA roticulator stapler (12 mm) with 4.8-mm (green) or 3.5-mm (blue) cartridges according to the tissue thickness and cystic artery ligation (Fig. 1). While the 3.5-mm cartridges were applied to the patients with difficult and edematous CD, the 4.8-mm cartridges were used for subtotal cholecystectomy. The Endo-GIA must be behind the CD, and the

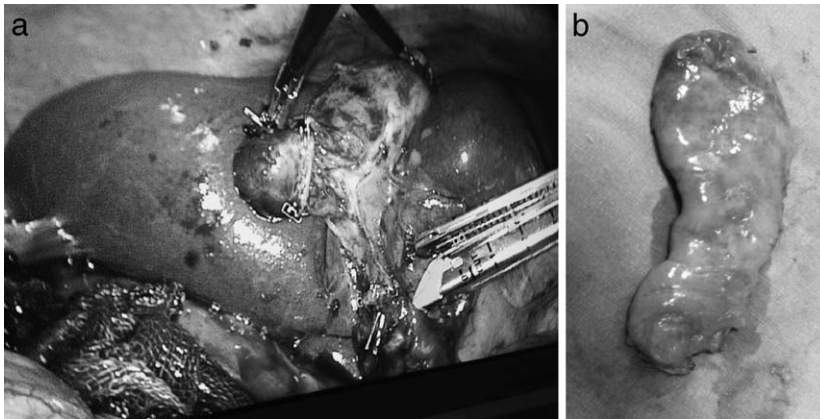


Fig. 2 Stapler lines (A) and gallbladder (B) after cholecystectomy.

locking mechanism should be free of any intervening tissue before firing. Before firing the Endo-GIA, especially for the patients with millimetric stones, we squeezed the CD toward the gallbladder with a laparoscopic dissector to ensure there was no stone in the difficult CD. In some patients, the fundus-first method and subtotal cholecystectomies were performed for unclear anatomy of the Calot's triangle. In 3 patients, ligation of the cystic artery was not possible, and we used fibrin sealant (Tisseel Kit; Baxter Healthcare Corporation, Westlake Village, California) to avoid the possibility of bleeding. The gallbladder was dissected from the liver using electrocautery and removed with an endobag via the umbilical incision. Finally, the CD stump was carefully examined, and a soft drain was inserted via the 5-mm trocar incision and placed in the foramen of Winslow. We examined the gallbladder and cystic duct for the stapler line (Fig. 2).

Results

During the study period, 19 patients underwent LC with CD closure using the Endo-GIA roticulator. There were 12 men and 7 women ranging in age from 41 to 73 years, with a mean age of 62 years.

The preoperative diagnoses included symptomatic gallstones with or without CBD stones (10 patients), acute cholecystitis (7 patients), acute cholecystitis with acute cholangitis (1 patient), and biliary pancreatitis (1 patient). One patient with acute cholangitis, 1 patient with biliary pancreatitis, and 3 patients with symptomatic gallstones underwent preoperative ERCP. Four patients had CBD calculi extracted, and 1 patient with biliary pancreatitis was reported to have a normal examination.

The mean operation time was 91.3 minutes (range, 40–165 minutes). All patients were success-

fully treated with the laparoscopic approach, and none of the patients were converted to open surgery. Abdominal drains were used in all patients.

There were no deaths. Four patients (21%) with umbilical wound infections were treated with drainage and antibiotics. The umbilical wound infections occurred because an endobag was not used in the first 4 patients. The length of hospital stay was 3.4 days after operation.

The length of follow-up ranged from 1.0 to 50.4 months. No other complications were discovered during the follow-up period. The Endo-GIA roticulator 45-4.8 was the most frequently used stapler for closing the CD stump.

Discussion

LC was initially considered to be contraindicated for acute gallbladder inflammation, but it is currently a feasible and safe procedure for acute cholecystitis. It is advised mostly in the period known as the "golden 72 hours" from the onset of the symptoms.^{4,7,20–23} However, the treatment modality for patients admitted later than the golden 72 hours is still unclear. The widely accepted treatment modality for patients admitted in this period is an elective cholecystectomy, performed weeks after strict medical therapy called "cool down." However, more than 20% of these patients failed to respond to the medical management or suffered from recurrent cholecystitis in the interval period, leading to one or more readmissions and to unplanned urgent surgery in more than 50%. One of the most significant problems in patients who have undergone cool-down treatment is dissection difficulty in Calot's triangle. According to a meta-analysis, the conversion rates for acute calculous cholecystitis in this group was 25.7%.²⁴ The reason for the high

conversion rates for interval laparoscopic cholecystectomy (ILC) groups in the literature can be explained by dense adhesions around Calot's triangle. Waiting for an inflamed gallbladder to cool down allows maturation of the surrounding inflammation and results in the organization of adhesions, which makes the dissection more difficult. Although inflammation in the early stages may not necessarily involve Calot's triangle, chronic inflammation often scars and distorts Calot's triangle, which makes dissection in this critical area more difficult.²⁵

The laparoscopic subtotal cholecystectomy offers the advantages of the minimally invasive approach and definitive surgery for the "difficult" gallbladder. In the laparoscopic era, obscure anatomy accounts for a large number of conversions to conventional cholecystectomy.³

It is important to recognize the difficult gallbladder intraoperatively so that the decision to perform a laparoscopic subtotal cholecystectomy can be made early in the procedure.³ CD stones may be encountered during LC. Prior to a laparoscopic subtotal cholecystectomy, clearance of any stones is always performed. These stones are extracted by opening the duct if the stones are small, or by pulling up the large stones. Our study reports 19 patients with dilated and difficult CDs that were successfully ligated with the Endo-GIA. The posterior dissection to identify the angle between the infundibulum and the cystic duct is performed first. The creation of a window and the dissection of the gallbladder from the liver bed to ensure that no other structure returns to the porta hepatis is always performed, so the biliary anatomy is clearly identified. Avoidance of injury to the biliary duct is of great importance, especially during the performance of a difficult laparoscopic cholecystectomy.³ Indeed, our cases were not subtotal cholecystectomy, because dissection was brought to the cystic duct. It may be referred to as near total cholecystectomy.

Several methods have been proposed for ligating the CD during LC including a titanium or absorbable endoclip, an endoloop, a tie, an ultrasonic or bipolar sealer, and the Endo-GIA stapler.¹³⁻¹⁹

The CD joins the gallbladder to the common hepatic duct to form the common bile duct, and the diameter ranges from 1 to 5 mm.²⁶ Ligating or clipping of the CD in acute cholecystitis is difficult because of its diameter, especially when the diameter is >1 cm. Multiple clips may be dangerous. Clip-related complications have been a problem with metallic clips. One study reported 9 bile leaks among 650 patients who underwent LC, and 3 of

these leaks (0.46%) were caused by clip dysfunction.²⁷ Some authors reported patients with obstructive jaundice and CBD stone formation resulting from the migration of metallic clips into the CBD.^{28,29}

Knotting and suturing the CD is time consuming and cannot secure CD closure. Intracorporeal suturing and knotting are more advanced laparoscopic skills.³⁰

Ultrasonic coagulation and electrothermal bipolar sealers are useful in dissecting dense tissues in cases with acute inflammation. However, ultrasonic coagulation and electrothermal bipolar sealers are dangerous and can cause bile leakage.¹⁹ In one study, bile leaks were reported in 9 of 331 patients (2.7%) when a harmonic scalpel was used alone.¹⁸ A study of 100 LCs performed using a harmonic scalpel recommended that additional cystic duct ligatures be used for a cystic diameter exceeding 5 mm. Although the harmonic scalpel is expensive, it can be used for the entire operation, including the cystic artery occlusion and gallbladder dissection, and it shortens the operating time.^{18,31}

The endoloop may be an alternative, but for applying the endoloop you should divide the CD and then apply the endoloop. It is difficult to ligate if the CD is separated because the remnant CD can retract.¹³

Laparoscopic stapling devices have been applied in several operations, and they are reported to be a safe and feasible method of cystic duct closure. The division and clipping of the CBD have been widely discussed, and it is the most feared complication. One disadvantage of using endoscopic staplers in this setting is the need for larger ports (minimum 12-mm diameter) to introduce them.^{30,32}

In many laparoscopic procedures, stapling devices are useful for safely dividing structures, ligating vessels, and creating anastomoses. The technical failure of staplers, resulting in uncontrolled bleeding or anastomotic leakage when the staple line fails to close securely, has been reported. However, these complications are rare. The advantages of laparoscopic stapling devices are their relative ease and speed of use, and the shorter operating time.^{19,30}

The Endo-GIA is safe and easy to use. The CD anatomy should be clear, and adequate space should be left before firing the stapler device. A CD stone may slip into the CBD, so retraction is important; and before applying an Endo-GIA, the CD should be squeezed toward the gall bladder to prevent crushing a CD stone.³²

Other studies have used the Endo-GIA vascular stapler. It may be used at a dilated CD, but we think it may be dangerous in acute cholecystitis because the CD is very edematous and thick. We prefer the Endo-GIA roticator with a 4.8-mm or 3.5-mm thickness. In 16 cases, we isolated and ligated the cystic artery; but in the remaining 3 cases, we could not isolate the cystic artery and we divided the CD with a stapler. In these 3 cases, we used fibrin sealant to avoid bleeding. Three cases not in the fibrin-sealant group each had a small hematoma that resolved spontaneously.

The fundus-first dissection can be carried out during LC. Starting the dissection at the easiest site and obtaining the proper orientation is the most important principle in achieving a successful LC in difficult cases.³²

The complication rates seem to be higher than other studies (36.8%). These complications are minor and include small hematomas at the surgical site and limited port-site infections. We routinely used abdominal ultrasound to examine patients for possible complications at the beginning and discovered small hematomas in some patients. At the beginning of the study, we did not use the endobag for the removal of the infected gallbladder, and gallbladder perforation occurred during the extraction. At the beginning of the study, the rate of wound infection was higher. We propose endobag usage in patients with an infected gallbladder.

The length of hospital stay was 3.4 days. The length of hospital stay is longer than standard laparoscopic cholecystectomy because at the beginning of the study, some patients stayed more than a week because of the fear of complication. After the 10th patient, the length of hospital stay decreased to 1 day, the same length as for non-stapled patients.

Conclusion

In conclusion, the Endo-GIA is a safe and easy treatment method for patients with a dilated and difficult CD. The cystic artery should be isolated and ligated if possible before firing the Endo-GIA stapler. If isolation and ligation is not possible, fibrin sealant can be applied to avoid bleeding. We recommend use of the endobag for stapled gall bladder to minimize port-site infection. The length of hospital stay is same as for the non-stapled group. The vascular Endo-GIA can be applied to a large CD, but for acute cholecystitis with an edematous CD, the Endo-GIA roticator 4.8 or 3.5 stapler is preferred.

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