

# Sealing of the cystic and appendix arteries with monopolar electrocautery during laparoscopic combined cholecystectomy and appendectomy

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## Abstract

The best method to ligate the arteries during laparoscopic cholecystectomy or appendectomy remains controversy. The aim of this study is to introduce a new approach during laparoscopic combined cholecystectomy and appendectomy using a monopolar electrocautery to seal the cystic and appendix arteries. We retrospectively reviewed data from 57 patients who underwent laparoscopic combined cholecystectomy and appendectomy between December 2006 and June 2016. Each laparoscopic combined cholecystectomy and appendectomy was performed by coagulating and sealing the cystic and appendix arteries. Absorbable clip or coils were then used to ligate the proximal of cystic duct and the stump of appendix. The other side of the cystic duct and appendix which subsequently were to be removed from abdomen were used titanium clips or silk ligature. Of the 57 patients, 3 patients (5.3%) were converted to open surgery due to severe abdominal adhesions or gallbladder perforation. The mean operative time was 56 minutes (range, 40–80 minutes). Mean blood loss was 12 mL (range, 5–120 mL), and the mean postoperative hospital stay was 3.0 days (range, 2–5 days). No postoperative bleeding, biliary leakage, infection, or mortality occurred. Monopolar electrocautery to seal the cystic and appendix arteries is a safe, effective, and economical surgical procedure during laparoscopic combined cholecystectomy and appendectomy. Further randomized controlled clinical trials are required to validate our findings.

**Keywords:** combined laparoscopic surgery, laparoscopic appendectomy, laparoscopic cholecystectomy, monopolar electrocautery

## 1. Introduction

With the advance of the laparoscopic techniques, combined surgeries are being increasingly performed by laparoscopy.<sup>[1–4]</sup> Laparoscopic combined cholecystectomy and appendectomy appear to be a technically feasible standard laparoscopic procedure to treat coexisting gallbladder and appendix benign disease.<sup>[5,6]</sup>

Nevertheless, there are still controversies about the details of the technique, particularly in the method of ligation of the arteries. Most surgeons utilize metal clips to seal arteries. However, many reports have described the disadvantages of using metal clips, which include endoclip slippage and migration into adjacent anatomic structures.<sup>[7,8]</sup> Absorbable

clips and ultrasonic devices have been provided good to close the arteries, but they are costly.<sup>[9–12]</sup>

Recently, several reports have shown that monopolar electrocautery to control the cystic or appendix artery is a safe, effective, and cost-efficient approach during laparoscopic cholecystectomy or appendectomy,<sup>[13–16]</sup> but this procedure is seldom reported during the combined laparoscopic surgeries in the literature. Here we present our experience with the use of monopolar electrocautery to seal the arteries during laparoscopic combined cholecystectomy and appendectomy.

## 2. Materials and methods

### 2.1. Patients

From December 2006 to June 2016, 57 patients (32 women and 25 men) who underwent elective or emergency laparoscopic combined cholecystectomy and appendectomy for acute/chronic calculus cholecystitis combined chronic/acute appendicitis, or gallbladder polyps combined acute/chronic appendicitis at the 117th and 322th Hospitals of the People's Liberation Army were considered. All the operations were performed by the same chief surgeon. An informed consent was obtained from all participants. The diagnosis of gallbladder disease and appendicitis was based on ultrasonographically or by computed tomography and accompanied by severe dyspepsia or pain, previous appendicitis, biliary pancreatitis, and abnormal blood test results. The preoperative data were recorded: sex, age, body mass index, American Society of Anesthesiologists risk class, disease, and associated comorbidities.

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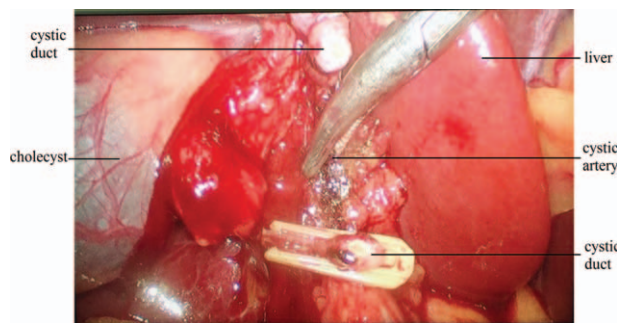
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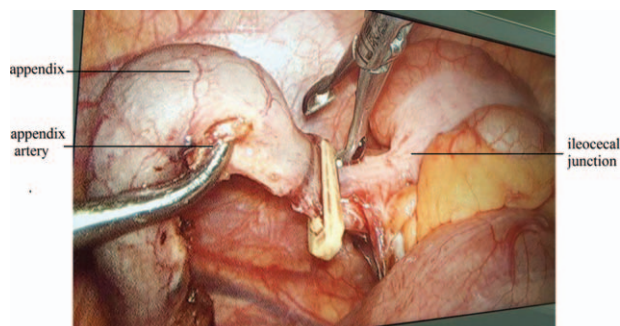
**Figure 1.** Sealing the cystic artery with a separate clamp.

## 2.2. Surgical technique

The chief surgeon in the present study had performed over 300 laparoscopic cholecystectomies successfully. Once the general anesthesia was used, patients placed in the standard reverse Trendelenburg position with a 15° left tilt. Surgery was then performed using a 3 trocars technique, a 10 mm trocar was placed at the edge of the umbilicus, the second 10 mm port was placed below the xiphoid 2 to 3 cm at the right edge of the ligament teres hepatis, a 5-mm trocar was placed on the right side of the midclavicular line to the umbilical level.

After insertion of the trocars, we first exposed and dissected of the triangle of Calot. The cystic duct was closed by applying one titanium clip on the gallbladder side (which subsequently was to be removed with the gallbladder later, *in vitro*), and applying 1 absorbable clip on the cystic duct side. Then, the cystic artery was sealed by using monopolar electrocautery, and point cautery was performed 2 or 3 times on the cystic artery with separate clamps. The cautery time was short, and cautery points were placed approximately 10 mm apart (Fig. 1). Gallbladder bed was separated with the electrocautery hook. Finally, the gallbladder was removed through the subxiphoid port.

Then, the patient was repositioned in the Trendelenburg position with a 25° left tilt. A fourth trocar (10 mm) was placed over the pubic symphysis 5 cm crossing of the ventral midline. After the appendix was freed from adhesions and the mesentery was exposed, we proceed to cauterize the appendicular artery with separate clamps from both sides of the mesentery (Fig. 2). After closure of the mesoappendix, the appendiceal stump was ligated with absorbable clip or absorbable coil. The other side of the appendix which subsequently was to be removed from abdomen used titanium clips or silk ligature. The appendix was sectioned and extracted through the fourth trocar. Drainage suction was only rarely left in place after the procedure.



**Figure 2.** Sealing the appendix artery with a separate clamp.

**Table 1**

### Demographics of 57 patients.

Characteristic	Number
Sex	
Female	32
Male	25
Mean age, y	42.5 ± 13.8
BMI, kg/m <sup>2</sup>	22.5 ± 1.3
ASA score (1/2/3)	23/24/10
Disease	
Acute calculus cholecystitis combined with chronic appendicitis	14
Chronic calculus cholecystitis combined with acute appendicitis	10
Chronic calculus cholecystitis combined with chronic appendicitis	18
Gallbladder polyps combined with acute appendicitis	6
Gallbladder polyps combined with chronic appendicitis	9
Comorbidity, %	21 (36.8)
Pulmonary	3 (5.3)
Cardiovascular	9 (15.8)
Diabetes	2 (3.5)
Liver dysfunction	7 (12.3)

## 3. Results

Of the 57 patients, 3 patients (5.3%) were converted to open surgery (severe abdominal adhesions in 2 patients and gallbladder perforation in 1 patient). As shown in Table 1, there were 32 females and 25 males. The mean age was 42.5 ± 13.8 years old. The body mass index was 22.5 ± 1.3 kg/m<sup>2</sup>. The number of patients for American Society of Anesthesiologists score 1, 2, 3 was 23, 24, 10, respectively. Fourteen patients were operated on for acute calculus cholecystitis combined with chronic appendicitis. Ten patients were operated on for chronic calculus cholecystitis combined with acute appendicitis. Eighteen patients were operated on for chronic calculus cholecystitis combined with chronic appendicitis. Six patients were operated on for gallbladder polyps combined with acute appendicitis. Nine patients were operated on for gallbladder polyps combined with chronic appendicitis. Thirty-two patients had associated comorbidities.

As shown in Table 2, the mean operative time was 56 minutes (range, 40–80 minutes). The mean blood loss was 12 mL (range, 5–120 mL). The mean postoperative hospital stay was 3 days (range, 2–5 days). There were no incidences of postoperative bleeding, biliary leakage, infection, or mortality occurred.

## 4. Discussion

It is not rare for a patient to have coexistent disease of the gallbladder and appendix during laparoscopic techniques.<sup>[1,5,6]</sup> In parallel the simultaneous laparoscopic surgery appear to be a

**Table 2**

### Data of outcomes.

Variable	Value
Operative time, min	56 (40–80)
Intraoperative blood loss, mL	12(5–120)
Postoperative hospital stay, d	3 (2–5)
Conversion rate, %	3 (5.3)
Gallbladder perforation	1 (1.8)
Severe abdominal adhesions	2 (3.5)
Post-operative complications	0

technically feasible standard procedure to treat these diseases.<sup>[5,6]</sup> It offers patients the advantages of less visible scarring, reduced postoperative pain, shortened recovery times, and hospitalization.<sup>[5,6]</sup> However, surgeons are also should seek to more advantages by decreasing the cost and improving the quality of life. We thought that the use of expensive devices such as the ultrasonic may not be necessary in routine cholecystectomy or appendectomy. In addition, the traditional metal clips dwelling in the abdomen after surgery may lead to many complications, which include the metal clips eroded the cystic duct and migrated into the common bile duct,<sup>[7,8]</sup> the imaging properties of metallic clips on computerized tomography and magnetic resonance imaging may interfere with imaging scans.<sup>[17,18]</sup> In this study, we used monopolar electrocautery to seal the cystic and appendix arteries, the proximal part of cystic duct and the stump of appendix that were occluded with 1 absorbable clip or absorbable coils during laparoscopic combined cholecystectomy and appendectomy. There was no postoperative bleeding, biliary leakage, infection, or mortality occurred. Moreover, after 6 months, the absorbable materials will degrade by hydrolysis and left only a fibrous tissue scar.<sup>[14]</sup>

Since the beginning of application of monopolar electrocautery to control the cystic or appendix artery during laparoscopic surgery in 2006, we have performed over 300 laparoscopic cholecystectomies using metal clips. During this period, we began to use monopolar electrocautery cystic or appendix artery and demonstrated that monopolar electrocautery artery was safe and effective procedure. Then, some patients had coexistent disease of the gallbladder and appendix during laparoscopic techniques, and they were pleased to receive a combined surgery. In this regard, we made an attempt to use of monopolar electrocautery to seal the cystic and appendix arteries during laparoscopic combined cholecystectomy and appendectomy. The initial results of this study have shown that the procedure can be safely performed.

One may argue that the safety of using the monopolar electrocautery alone to control the cystic and appendix arteries because monopolar electrocautery arteries may not be adequacy of hemostasis or may cause collateral tissue injury. Especially for cystic artery, the anatomic variations in and around Calot's triangle are frequent, cystic artery variations are to be found in 20% to 50% of cases.<sup>[13,19-22]</sup> However, we noted an increasing trend among surgeons using monopolar electrocautery to control the arteries during laparoscopic techniques, and proved that monopolar electrocautery to control the cystic or appendix artery is safe and effective during laparoscopic cholecystectomy or appendectomy.<sup>[13-16]</sup>

In our experience, the crucial step during the surgery is to cautery cystic artery. During cystic artery electrocoagulation, accurate identification of the anatomy of the cystic artery is very important. Misuse of cautery to dissect Calot's triangle has been recognized as a possible cause of bile duct injury.<sup>[23]</sup> We can avoid bile duct injury by taking simple precautions like to apply the cautery very close to the gallbladder and preferably laterally from the cystic lymph nodes. The cystic artery is cauterized at 2 or 3 different time points with separate clamps. The coagulation points are approximately 10mm apart. Sometimes, it is subsequently lifted on the break end to perform the coagulation. The separation clamp should not be in contact with the bowel, liver or with other structures.

In conclusion, during laparoscopic combined cholecystectomy and appendectomy using monopolar electrocautery of the arteries, occlusion of the proximal of cystic duct and the stump of appendix with one absorbable clip or absorbable coils is a safe, effective, and economical surgical procedure. Moreover, the absorbable materials will degrade by hydrolysis and left only a

fibrous tissue scar. No artifacts are created on subsequent computed tomography or magnetic resonance imaging scans. Further randomized controlled clinical trials are required to validate the findings of the present study.

## Author contributions

**Conceptualization:** C. Yang, J. Cao.

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**Writing – original draft:** C. Yang, G. Liu, J. Cao, Y. Mao.

**Writing – review & editing:** C. Yang, G. Liu, J. Cao, Y. Mao.

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