

Closure of the Cystic Duct Comparison Ultrasonic Harmonic Scalpel versus Clip Application in Laparoscopic Cholecystectomy

Hazem Ahmed M. Badr

General Surgery Department, Faculty of Medicine for Girls Al-Aazhar University

ABSTRACT

Background: Laparoscopic cholecystectomy (LC) is usually performed using titanium clips (TC) for occlusion of the cystic duct and cystic artery. The use of Harmonic scalpel (HS) in LC has been reported.

Aim: This study aimed to compare effect of HS and clips application for closure of the cystic duct and artery in patients undergoing LC. **Patients and Methods:** Totally 50 patients were operated using LC technique from April 2010 to April 2012. Patients were retrospectively, divided into 2 groups according to the instruments used for division of the cystic artery and duct as well as for dissection of the liver bed. On the one hand, group 1 consisted of 30 patients who were all treated with the ultrasonic harmonic scalpel as the sole instrument used in the whole procedure. On the other hand, group 2 comprised 20 patients in whom dissection and coagulation were performed using monopolar coagulation, and occlusion of the artery and duct with clips. The operative time, postoperative hospital stay, morbidity, and mortality for each group were analyzed and compared with each other. **Results:** The 2 groups were comparable for age, sex, indication for cholecystectomy, and combined procedures. Patients were randomly treated either with the ultrasonic HS or with clips. Postoperative hospital stay of all patients in the group 1 and group2 was 2 days. Superficial wound infection seen in one patient (2%) in group 2 which was treated by oral antibiotics. During the follow-up period, one port-site hernia was detected in one patient (2%) in group 2. One case (2%) of peritoneal fluid collection seen in (group 1) and treated with percutaneous drainage was found.

Conclusions: The use of harmonic scalpel was accepted as a reasonable alternative for closure of cystic ducts < 4 mm in diameter. This Study has shown that the HS is an effective and safe tool for the closure of both the cystic duct and artery in patients who undergo LC.

Key Words: Cystic duct, Ultrasonic harmonic scalpel, Clip application, Laparoscopic cholecystectomy.

Abbreviations: Laparoscopic cholecystectomy (LC), American Society of Anesthesiology (ASA), Body Mass Index (BMI), endoscopic retrograde cholangiopancreatography (ERCP), titanium clips (TC) Harmonic scalpel (HS).

INTRODUCTION

Laparoscopic cholecystectomy (LC) is considered world wide the “gold standard” in the surgical treatment of symptomatic gall bladder lithiasis and acute cholecystitis, because it offers well-known and more definite advantages in comparison with the laparotomic procedure. ⁽¹⁾

The standard laparoscopic cholecystectomy is usually performed using a monopolar electro-surgical hook for dissection and clips for occlusion of the cystic duct and cystic artery. Alternative techniques for duct ligation have included linear stapler, endoloops, or sutures, which are, however, seldom used. ⁽²⁾

Even if LC is considered a safe procedure, some pitfalls are associated with the use of the monopolar electric scalpel, such as the high risk

Of thermal injuries and significantly more common postoperative biliary complications.

Furthermore, not to be underestimated are visceral and solid organ injuries caused by the frequent instrument exchange, such as bile leakage due to slippage of the clips. ⁽³⁾

The ultrasonically activated scalpel (Harmonic) is introduced into clinical use more than a decade ago. Its technology relies on the application of ultrasound within the harmonic frequency range to tissues and allows 3 effects that act synergistically, coagulation, cutting, and cavitation. ⁽⁴⁾ The temperature obtained and the lateral energy spread are lower than those detected when the monopolar hook is used, thus reducing the risk of tissue damage. ⁽⁵⁾ The Harmonic scalpel is also an effective tool for closure of biliary ducts and vessels whose diameter is <4 mm to 5 mm. ⁽⁶⁾ Several studies have demonstrated the effectiveness and

safety of the use of the Harmonic scalpel for dissection of the gallbladder, but only a few researchers have examined its efficacy in the closure of the cystic artery and duct.⁽¹⁾ Thus, in an attempt to fill this gap, this study, albeit at a preliminary stage, aims to demonstrate that the ultrasonically activated scalpel is a safe instrument that, similarly to the standard clips, is effective for a correct and complete closure and division of the cystic duct and artery in LC.⁽⁷⁾

PATIENTS AND METHODS

During 2-years period, from April 2010 to April 2012, 50 consecutive laparoscopic cholecystectomies were performed in the Department of General Surgery, Al-Zharaa University Hospital, Al-Azhar University on patients affected by gall-bladder lithiasis; 16 patients were males, and 34 were females. The mean age for the whole patients was 46.5 ± 9.7 years (range, 20 to 65). All the patients were classified according to the American Society of Anesthesiology (ASA) physical status classification system, and their mean body mass index was 22.6 ± 4.6 (range, 12.7 to 39).

Patients were retrospectively divided into 2 groups according to the instruments used for division of the cystic artery and duct as well as for dissection of the liver bed. Group 1 consisted of 30 patients who were all treated with the ultrasonic harmonic scalpel (HS) as the sole instrument used in the whole procedure. On the other hand, group 2 comprised 20 patients in whom dissection and coagulation were performed using monopolar coagulation, and occlusion of the artery and duct with titanium clips (TC) (Figure 1). The two groups were comparable for age, sex, indication for cholecystectomy, and combined procedures. Patients were randomly treated either with the ultrasonic harmonic scalpel or with clips.

The 5 patients with stones in the common bile duct were previously treated with endoscopic retrograde cholangiopancreatography (ERCP) plus sphincterotomy and endoscopic stone extraction. In all cases, the endoscopic procedure was successful.

Surgical Technique

In all cases, the surgical procedure is carried out with patients under general anesthesia. They are supine with their legs extended, in an anti-

Trendelenburg position and inclined laterally to the left at an angle of 30 degrees to facilitate exposure of the hepatic region. A gastric tube is placed into the stomach at the beginning of the procedure. Prophylactic intravenous antibiotics are administered before surgery. The first surgeon stands between the patient's legs, and the 2 assistants stand on the patient's left and right side. The laparoscopic equipment is placed on the cranial right side of the operating table. A 12-mm trocar is introduced into the peritoneal cavity and placed in the periumbilical site with an open technique, and pneumoperitoneum to a pressure of 12 mm Hg is created.

A 30° laparoscope is introduced through the umbilical trocar (1), and 3 operative trocars are inserted in the left hypocondrium (12mm) (trocar 2), right hypocondrium (5mm) (trocar 3), and right hip (5mm) (trocar 4) under video guidance. A grasper forceps is inserted through trocar 3 to grasp and draw the gallbladder fundus towards the right axilla, and a second grasper is introduced through trocar 4 to apply gentle rightward traction on the infundibulum, thus improving the exposure of Calot's triangle. Group 1 (Harmonic): the Harmonic scissors are inserted through trocar 2 and used as a dissector for dissection of the cystic artery and duct (Figure 2). When both artery and duct are well visualized and isolated, their section is performed with a single application of ultrasonically activated scissors on minimum position (Figure 3). It is important to close the blades carefully and slowly and to avoid lateral traction on the structure. In case of large cystic ducts (with an external diameter exceeding 4mm), an additional ligature with clips is performed. To assess its diameter, the duct is positioned between the blades of the ultrasonically activated scalpel: if the cystic duct cannot be entirely included between them, an extra ligature is necessary. The additional clips are placed on the cystic duct that is then sectioned distally using the Harmonic scalpel.

Statistical analyses: The mean \pm standard deviation (SD) was used to represent quantitative data. Frequency and percents were used to represent qualitative data. The t-students, chi-square (χ^2), and Fisher exact tests were used to find out the significance between the two groups. The significance level was adjusted at the P-value < 0.05 .

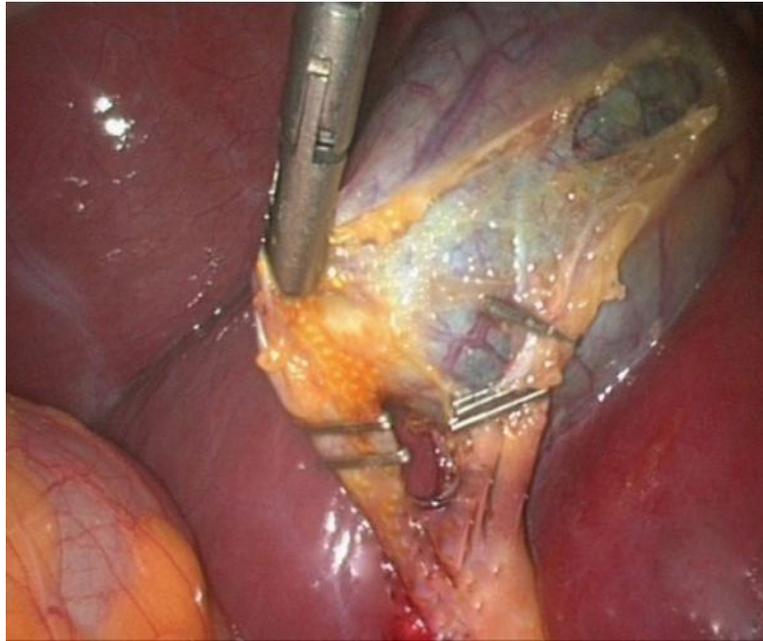


Figure (1): Occlusion of the artery and duct with clips

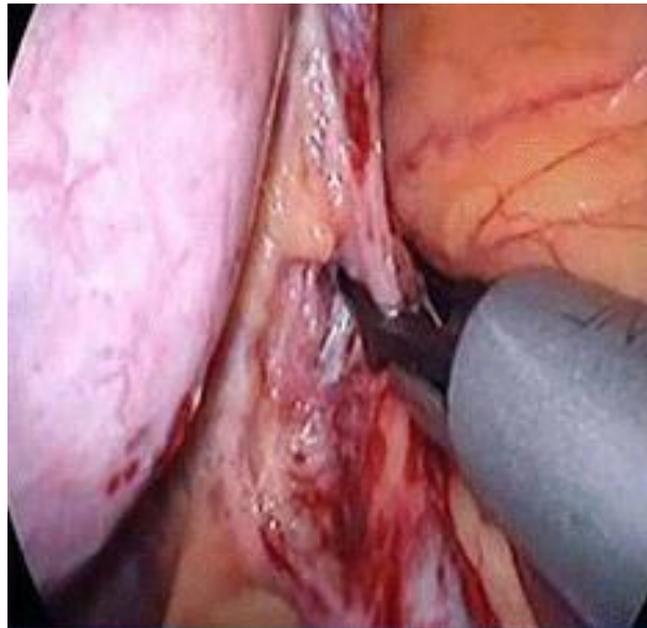


Figure (2): Dissection by harmonic scalpel

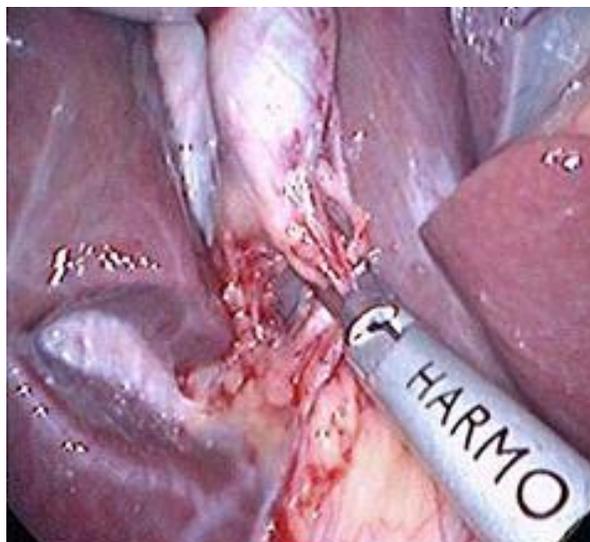


Figure (3): Dissection and division of the cystic artery and duct by harmonic scalpel

RESULTS

A total of 50 patients were operated with ultrasonically activated scalpel (harmonic scalpel) and ligature of cystic duct and cystic artery by clips from April 2010 to April 2012.

The two groups were comparable i.e. no statistically significant differences for age, gender, indication for cholecystectomy, and combined procedures. Patients were randomly treated either with the ultrasonic harmonic scalpel or with clips (**table 1**).

The mean operative time and postoperative hospital stay for each group were analyzed and compared with each other. Laparoscopic cholecystectomy was successfully completed in all patients. The mean operating time (from the first skin incision to the last skin stitch) of the groups 1 and 2 (without combined procedure) was 60 ± 36 minutes and 82 ± 47 minutes, respectively statistically significant difference (**table 2**). Mean postoperative hospital stay of all patients in the group 1 and group 2 was 2 days. Absence of mortality was observed in the postoperative period. Superficial wound infection seen in one patient in group 2 which was treated by oral antibiotics. During the follow-up period, one port-site hernia was detected in one patient in group 2. One case of peritoneal fluid collection treated with percutaneous drainage (group 1) in patient with severe acute cholecystitis. No statistically significant differences regarding these variables (**table 3**).

On the basis of the subdivision of the cases into the 2 groups under study, and compared all clinical results. As far as morbidity one patient (group 1), and mean hospital stay 2 days, are concerned, no statistically significant difference has been recognized between the two groups. Nevertheless, mean operative time was 60 ± 39 minutes in group 1 versus 85 ± 51 minutes in group 2 when considering the whole series, whereas it was 60 ± 36 minutes vs. 82 ± 47 minutes when considering those patients who did not undergo additional procedures. Overall, a statistically significant difference has resulted from the use of the harmonic scalpel (Group 1) compared with clips (Group 2), which makes the former more advantageous than the latter.

DISCUSSION

Closure of cystic duct during laparoscopic cholecystectomy using clips is the most frequently used technique, **Wise et al.** ⁽⁸⁾ demonstrated that simple clips applied to the cystic duct could not be displaced by a pressure of 300 mmHg. Unfortunately, the literature provides various examples of cystic-duct leakage, due to inadequate closure of the duct, due to mismatch of the clip arms, necrosis of the duct at the site of clipping, or slippage of the clips off the end of the duct and migration into the biliary tract. ⁽⁹⁾ In recent years, some energy sources have been tried for the closure of the cystic duct. The use of ultrasonically activated shears (harmonic) for both dissection and

closure-division of the cystic duct and artery was reported.^(5,8,10)

This study clearly demonstrates that the harmonic scalpel is an effective and safe tool for the closure of both the cystic duct and artery in patients who undergo laparoscopic cholecystectomy. The results showed a statistically significant difference in the average operative time, which makes the procedure performed with the Harmonic scalpel preferable.

This is motivated by the use of the Harmonic scalpel as the sole instrument, which prevents the extraction and insertion of different instruments and subsequent waste of time. In addition, the electronically activated Harmonic scalpel produces almost no smoke.⁽¹¹⁾ Thus, the visibility of the operative field is preserved during the whole procedure, and there is no need to remove the smoke and to recreate the pneumoperitoneum.⁽¹²⁾

Laparoscopic cholecystectomy performed with an ultrasonically activated scalpel is feasible and effective.⁽¹³⁾ The method offers several considerable advantages, such as the utilization of a single instrument both for dissection of the gallbladder from the hepatic bed and division of the artery and duct. Furthermore, because of the minimal thermal dispersion, the use of the Harmonic reduces the risk of injuries.⁽¹⁴⁾ Nevertheless, the main obstacle hindering the applicability of the procedure is the cystic duct size: if it exceeds 4mm to 5mm in diameter, an additional ligature is necessary.⁽¹⁵⁾

CONCLUSIONS

The use of harmonic scalpel was accepted is a reasonable alternative for closure of cystic ducts < 4 mm in diameter. The study showed a statistically significant difference in the average operative time in the two groups, which makes the procedure performed with the harmonic scalpel preferable. This is motivated by the use of the harmonic scalpel as the sole instrument, which prevents the extraction and insertion of different instruments and subsequent waste of time.

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Table (1): Preoperative Data of the Studied Patients

Variables	Studied groups (n=50)				* χ^2 -value **t-value	P-value
	Group 1 (n=30)		Group 2 (n=20)			
	No.	%	No.	%		
Gender:						
Male	10	33.3	6	30.0	0.06*	0.804
Female	20	66.7	14	70.0		
Age (years): Mean± SD	48.5±10.8		47.6±9.7		0.307**	0.62
Indication for LC operation:						
Acute cholecystitis	3	10.0	3	15.0	0.29*	0.961
Simple gall stones	21	70.0	13	65.0		
Common bile duct stone	3	10.0	2	10.0		
Preoperative ERCP*	3	10.0	2	10.0		

*FE= Fisher exact test

Table (2): Intraoperative Data of the Studied Patients

Variables	Studied groups (n=50)		t-value	P-value
	Group 1 (n=30)	Group 2 (n=20)		
	Mean± SD	Mean± SD		
Mean operative time (minute): With combined procedure	60 ± 39	85 ± 51	-1.860	0.034
Mean operative time (minute): Without combined procedure	60 ± 36	82 ± 47	-1.775	0.04

Table (3): Postoperative Data of the Studied Patients

Variables	Studied groups (n=50)				*t-value **FE	P-value
	Group 1 (n=30)		Group 2 (n=20)			
	No.	%	No.	%		
Post-operative stay: Mean± SD	2 ± 2		2 ± 2		Equal averages: no difference	
Complications:						
Peritoneal fluid collection	1	2.0	0	0.0	FE**	1.0
One port-site hernia	0	0.0	1	2.0	FE**	0.4
Superficial wound infection	0	0.0	1	2.0	FE**	0.4
Mortality in postoperative period	0	0.0	0	0.0	Statistics can't done	

*FE= Fisher exact test