

## A COMPARATIVE STUDY OF MONOPOLAR ELECTROCAUTERY VERSUS ULTRASONIC DISSECTION OF THE GALLBLADDER FROM THE GALLBLADDER BED IN LAPAROSCOPIC CHOLECYSTECTOMY

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### Abstract

**Background:** To determine the incidence of gallbladder perforation during dissection from the liver bed by monopolar electrocautery versus harmonic shear and its intraoperative consequences. **Materials and Methods:** This study was conducted at Department of Surgery, Jawaharlal Nehru Medical College and Hospital, Aligarh Muslim University, Aligarh from November 2018 to October 2020 involving adult patients with symptomatic gallstone disease who were eligible for laparoscopic cholecystectomy. Patients were randomly assigned before administration of anaesthesia to electrocautery or harmonic scalpel groups. Both groups were compared for incidence of gallbladder perforation during dissection, bile leak, stones spillage, bleeding, number of times lens cleaning and duration of surgery. **Result:** A total of 100 patients were included with 50 patients in each group. The overall incidence of Gallbladder perforation was 13% (18% in electrocautery vs. 8% in ultrasonic group),  $p=0.234$ . Bile leak occurred in all patients who had gallbladder perforation,  $p=0.234$ . Stone spillage occurred in 8% of electrocautery group and 4% in harmonic group ( $P=0.678$ ). Number of times lens cleaned in electrocautery group. ( $2.46\pm 0.68$ ) and Harmonic group ( $1.62\pm 0.57$ ),  $p<0.001$ . The mean operative time in electrocautery group was 35.46 minutes vs. 29.72 minutes in Harmonic group ( $p=0.016$ ). Minor bleeding occurred in electrocautery group (26.0%) vs. harmonic group (20.0%),  $p=0.476$ . Mean duration of hospital stay in Electrocautery group (2.18 days) vs. harmonic group (2.0 days),  $p=0.465$ . **Conclusion:** Harmonic Scalpel is safe and effective for the haemostatic dissection during laparoscopic cholecystectomy and can replace electrocautery for this purpose if available at operative theatre.

## INTRODUCTION

Laparoscopic cholecystectomy is the “gold standard” for the surgical treatment of symptomatic gallstone disease. The standard laparoscopic cholecystectomy is commonly performed by means of specialized instruments. For gallbladder dissection, the electrosurgical hook, spatula, and/or scissors using high frequency Monopolar technology have been used in most centers. Occlusion by Simple metal clips is frequently used to achieve both cystic duct and artery closure.<sup>[1]</sup> In laparoscopic surgery, instruments using a variety of energy sources to cut and coagulate tissues have been used including electrocautery, Carbondioxide(CO<sub>2</sub>) laser and ultrasonic scalpel. At present, Monopolar electrocautery is the main cutting method used for gallbladder dissection from the liver

bed. But it is associated with local thermal and distant tissue damage which might cause inadvertent perforation of the gallbladder during gallbladder bed dissection.<sup>[2]</sup> Gallbladder perforation during dissection from the liver bed with spillage of bile and loss of stones in the peritoneal cavity is a common operative problem during laparoscopic cholecystectomy,<sup>[3]</sup> which disrupts the flow of surgery and prolongs its duration. The incidence of gallbladder perforation during laparoscopic cholecystectomy has been reported to be 20%–40%.<sup>[4]</sup>

For safe, effective and careful dissection of the gallbladder in laparoscopic cholecystectomy, diverse surgical apparatus have been developed aiming to decrease intra and postoperative complications to the lowest level.<sup>[5]</sup> At the present time, in addition to

electrocautery, various ultrasonic scalpel, water jet dissectors, laser systems, and specially prepared suction devices have been used. During dissection with various efficacy, all these varieties of equipment can attain complete hemostasis.<sup>[6]</sup>

The ultrasonically activated (Harmonic) scalpel was designed as a safe alternative to electrocautery for the haemostatic dissection of tissues. The primary use of the Harmonic scalpel in laparoscopic cholecystectomy has been used for the division of the cystic artery and liver bed dissection. This innovative technology relies on the application of ultrasound within the harmonic frequency range to tissues and allows two effects; ultrasonic coagulation and cavitation effects provided by a rapidly vibrating blade contacting various tissues.<sup>[7]</sup> The heat generated as a result of stress and friction is below 80 degree Celsius. As a result, tissue charring and desiccation from loss of moisture is minimized. The cavitation or cutting effect is produced by a relatively sharp blade vibrating 55,500 times per second over a distance of 60–100 µm. It cuts the tissue by stretching it beyond its elastic limit and by breaking molecular bonds. The resulting decrease in temperatures, smoke, lateral tissue damage and more precise dissection by using the Harmonic scalpel is a better alternative to more traditional electrocautery.<sup>[8]</sup> The incidence of gallbladder perforation also has been reported to be low with ultrasonic dissection compared to electrocautery during laparoscopic cholecystectomy.<sup>[9]</sup> It provides a superior alternative to the currently used high frequency monopolar technology in terms of a lower incidence of gallbladder perforation especially in patients with complicated gallbladder disease and a shorter duration of surgery.<sup>[10]</sup>

## MATERIALS AND METHODS

This study was conducted at Department of Surgery, Jawaharlal Nehru Medical College & Hospital, Aligarh Muslim University, Aligarh from November 2018 to October 2020 involving adult patients with symptomatic gallstone disease who were eligible for laparoscopic cholecystectomy. 100 patients were randomly assigned before administration of anaesthesia to electrocautery or ultrasonic dissection groups. In the ultrasonic group, dissection of the gallbladder was performed using Harmonic Ace curved shears (Ethicon Endo-Surgery, Johnson & Johnson Co.) The study was conducted after institutional ethics committee approval, and we obtained written informed consent from each patient before enrolment in this study. The inclusion criteria for selection of patients were: Patients  $\geq 14$  years of age, symptomatic gallbladder stone disease eligible for laparoscopic cholecystectomy and the exclusion criteria were: Patients not giving consent for inclusion in the study, less than 14 years of age, CBD stones, Suspected/proven gallbladder malignancy, Conversion into open cholecystectomy. Preoperative data of each patient, including age, sex, body mass

index (BMI), presenting symptoms, comorbidities if any, and ultrasonography findings, were recorded.

Operative procedures were performed under General Anaesthesia with standard 4 ports North American technique. CO<sub>2</sub> pneumoperitoneum was created using Verses needle or open method. Dissection of gallbladder from liver bed was started from the infundibulum and worked superiorly using electrocautery or harmonic scalpel to remove gallbladder from the gallbladder bed. The overlying fat was grasped and pulled out and downward until the cystic duct was seen. The cystic artery and the duct were identified secured and divided. Mobilization of the gallbladder from the liver bed was done by electrocautery or harmonic shear as allocated by randomization for the study. Gallbladder was extracted from either epigastric port. Any intra-operative complications in the form of bleeding and severity were recorded. Biliary complications in the form of gallbladder perforation with or without bile leak or spillage of stones into the peritoneal cavity were recorded. The operative times and the number of times the lens cleaned during surgery were recorded. Duration of in-hospital stay and cost of the procedure were also recorded.

## Statistical analysis

The data of both the group was compared with each other and statistically analyzed using Statistical Package for Social Sciences software version 25.0 for windows (SPSS Inc.) using the Chi-square and Student's T test.

## RESULTS

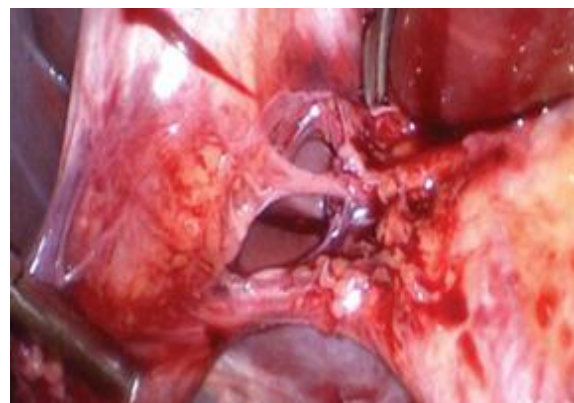
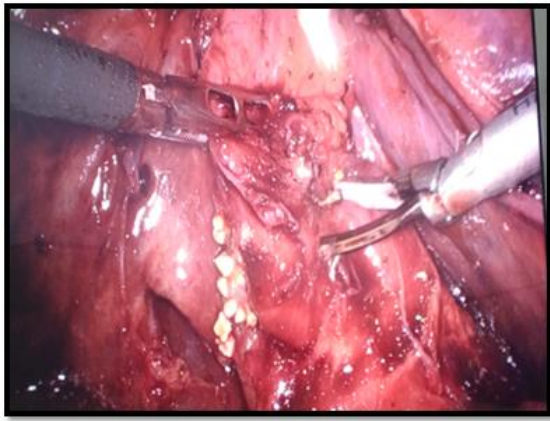


Figure 1: Peroperative picture showing calot's triangle.



Figure 2: Laparoscopic cholecystectomy using monopolar electrocautery and harmonic scalpel



**Figure 3: Laparoscopic cholecystectomy Showing GB perforation with stone spillage**

The study included 100 patients. 50 patients belonged to Monopolar electrocautery group and 50 patients belonged to Harmonic scalpel group. Both groups were comparable with respect to age, sex, BMI, presenting symptoms, comorbidities, preoperative ultrasonography findings and intraoperative

complicating factors (Tables 1 and 2). The age range of all patients was between 19 and 70 years, the median age for the electrocautery group was 43 years, and 41 years for the harmonic group. The overall incidence of gallbladder perforation was 13% (18% in the electrocautery group vs. 8% in the ultrasonic group,  $p=0.234$ ). Bile leak occurred in all patients who had gallbladder perforation,  $p=0.234$ . Stone spillage occurred in 8% of electrocautery group and 4% in harmonic group ( $P=0.678$ ). Number of times lens cleaned was significantly higher in electrocautery group ( $2.46\pm0.68$ ) than Harmonic group ( $1.62\pm0.57$ ) ( $p<0.001$ ) The mean operative time in electrocautery group was 35.46 minutes and in Harmonic group was 29.72 minutes ( $p=0.016$ ). Minor bleeding occurred in 26.0% of electrocautery group and 20.0% in harmonic group ( $p=0.476$ ) and rest of the patients showed no bleeding. Mean duration of hospital stay in Electrocautery group was 2.18 days and in harmonic group was 2.0 days which was insignificantly associated among the groups ( $p=0.465$ ).

**Table 1: Demographic and clinical characteristics among patients randomly assigned to electrocautery or ultrasonic dissection**

Characteristic	Electrocautery Group (n=50)	Harmonic Group (n=50)	p-value
Age, mean year	43.7	41.02	0.255
Sex, male:female	1:3.5	1:2.1	0.260
Body mass index, mean	22.46	23.57	
Presenting symptoms			
Heartburn	21	10	0.031
Pain abdomen	48	42	0.096
Dyspepsia	34	24	0.068
Mean BMI	22.46	23.57	0.057
Comorbidities	8	5	0.266

**Table 2: Distribution of patients on the basis of USG findings**

USG Findings		Electrocautery Group (n=50)	Harmonic Group (n=50)	p-value
		No./%	No./%	
Gall Bladder Status	Contracted	6 (12.0%)	7 (14.0%)	0.463
	Distended	22 (44.0%)	16 (32.0%)	
Wall Thickness	<3mm	42 (84.0%)	45 (90.0%)	0.372
	>3mm	8 (16.0%)	5 (10.0%)	
Number of Stones	Single	12 (24.0%)	10 (20.0%)	0.810
	Multiple	38 (76.0%)	40 (80.0%)	
Pericholecystic Collection	No	46 (92.0%)	48 (96.0%)	0.678
	Yes	4 (8.0%)	2 (4.0%)	
Stone Size	<1cm	46 (92.0%)	45 (90.0%)	1.00
	>1cm	4 (8.0%)	5 (10.0%)	

**Table 3: Comparison of outcomes in the electrocautery and ultrasonic dissection groups**

OUTCOMES	Electrocautery Group (n=50)	Harmonic Group (n=50)	p-value
	No./%	No./%	
Gall Bladder Perforation	9 (18.0%)	4 (8.0%)	0.234
Bile Leak	9 (18.0%)	4 (8.0%)	0.234
Stone Spillage	4 (8.0%)	2 (4.0%)	0.678
CBD injury	0	0	
Mean number of times lens cleaned	$2.46\pm0.68$	$1.62\pm0.57$	<0.001**
Mean Operative Time (minutes)	$35.46\pm5.74$	$29.72\pm4.22$	0.016
Mean Hospital Stay (Days)	$2.18\pm0.51$	$2.0\pm0.42$	0.465

**Table 4: The type of bleeding in both the groups**

Bleeding	Electrocautery Group (n=50)	Harmonic Group (n=50)	p-value
	No./%	No./%	
Major **	0 (0.0%)	0 (0.0%)	0.476
Minor*	13 (26.0%)	10 (20.0%)	



No Bleeding	37 (74.0%)	40 (80.0%)	
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\*Minor bleeding means bleeding that needed only one interventional step to stop it without further instrumentation or change of the equipment (Single touch of electrocautery hook or harmonic scalpel without significant difference in time)

\*\*Major bleeding means bleeding which needed more than one step to control it or further instrumentation or change of the equipment. (Clipping of the offending bleeding or suturing or several touches of cauterization)

## DISCUSSION

Laparoscopic cholecystectomy is the revolutionary method for the treatment of gallstone disease and has now become the gold standard for the surgical treatment of symptomatic cholelithiasis. For safe, effective and careful dissection of the gallbladder in laparoscopic cholecystectomy, diverse surgical equipments have been developed, aiming to decrease intra and postoperative complications to the lowest level. At the present time, in addition to Monopolar Electrocautery, various ultrasonic scalpel, water jet dissectors, laser systems, and specially prepared suction devices have been used.

Two commonly used methods of dissection being in Laparoscopic Cholecystectomy include Monopolar Electrocautery and Harmonic scalpel. Harmonic scalpel uses ultrasound energy for dissection, cutting and coagulation at the same time, which results in low temperature, decreased smoke/ lateral tissue damage and enables it to replace four instruments (scissors, clipper, electrocautery hook, and grasper) that were used in traditional Laparoscopic Cholecystectomy, leading to less complications by avoiding frequent instrumentation and iatrogenic gallbladder perforations during dissection.

In our study the majority of the patients were in the age group 31-40 years with 36.0% in Electrocautery group and 34.0% Harmonic group followed by 41-50 years with 26.0% in Electrocautery group and 24.0% in Harmonic group and the association was found to be statistically insignificant ( $p=0.834$ ). The mean age was  $43.7 \pm 11.51$  years and  $41.02 \pm 11.87$  years respectively for the Electrocautery and Harmonic group ( $p=0.255$ ). Mahabaleshwar et al,<sup>[11]</sup> reported the mean age of 47.36 years for electrocautery group, while 45.3 years for harmonic group ( $p=0.55$ ).

Mahjob et al,<sup>[12]</sup> included 320 patients in their study and there were 222 females and 98 males which imply that the females were in majority similar to the present study.

In our study the majority of the patients were having only pain abdomen (96% vs. 84%) followed by dyspepsia (68.0% vs 48.0%) and heartburn (42% vs 20.0%) in electrocautery and harmonic group respectively. Mahabaleshwar et al,<sup>[11]</sup> reported the major presenting symptoms as pain abdomen, heartburn and dyspepsia but the association was statistically insignificant in all the three symptoms ( $p>0.05$ )

In our study, 8 patients had comorbidities (Hypertension, Diabetes Mellitus or thyroid problem) in electrocautery group and 5 patients in harmonic group. The association of co-morbidities in both the

group was found to be statistically insignificant ( $p=0.266$ ). Mahabaleshwar et al,<sup>[11]</sup> reported insignificant association regarding the comorbidities (Hypertension, Diabetes Mellitus) among the two groups. They found that 8 out of 30 patients of electrocautery group were having comorbidities and only 3 out of 30 cases of group harmonic were having comorbidities ( $p=0.32$ ).

In our study, there was decrease in number of gallbladder perforation from 18% to 8% ( $P=0.234$ ), bile leak from 18% to 8% ( $P=0.234$ ) and stone spillage from 8% to 4% ( $P=0.678$ ) in Harmonic group as compared to Monopolar Electrocautery group but the association was found to be statistically insignificant ( $p>0.05$ ). Janssen et al,<sup>[2]</sup> conducted a randomized clinical trial on 200 patients of Ultrasonic versus Electrocautery dissection of the gallbladder in Laparoscopic cholecystectomy reported that the incidence of gallbladder perforation dropped down drastically (16% for Ultrasonic dissection and 50% for Electrocautery group). Ramzanali et al,<sup>[13]</sup> conducted a study on 92 patients (46 in each group) reported that gallbladder perforation and stone spillage were less in Harmonic group as compared to Electrocautery group. Gallbladder was perforated in 2 cases of Harmonic Scalpel dissection whereas 3 cases in Electrocautery dissected cases. Furthermore stone spillage was seen in none of Harmonic Scalpel dissected cases while 4 cases of stone spillage were reported in mono-polar Electrocautery dissected cases.

Mahabaleshwar et al,<sup>[11]</sup> reported 90.0% of the patients in the electrocautery group required lens cleaning during surgery, whereas only 63.3% of the patients required lens cleaning in the ultrasonic dissection group, and the mean number of times that required lens cleaning per patient was twice in the electrocautery group and once in the ultrasonic dissection group ( $p=0.004$ ). The number of lens cleanings was very subjective, but the very need for lens cleaning (extracorporeal and intracorporeal) suggests the degree of difficulty and the duration of the surgical procedure.

In our study it was found that minor bleeding was 26.0% in electrocautery group and 20.0% in harmonic group while the association was statistically insignificant ( $p=0.476$ ) and the rest of the other patients showed no bleeding. Mahjob et al,<sup>[12]</sup> reported minor bleeding in 19 (11.1%) in electrocautery group and 15 (10.1%) in harmonic group ( $p=0.792$ )

In our study the mean operative time was significantly higher ( $p=0.016$ ) in electrocautery group ( $35.46 \pm 5.74$  minutes) than harmonic group ( $29.72 \pm 4.22$ ) while mean hospital stay was

insignificantly associated among the groups ( $p=0.465$ ). Ramzanali et al,<sup>[13]</sup> reported that the mean operative time was less in Harmonic scalpel dissected group than in electrocautery group i.e, 40 versus 80 min ( $p=.000$ ). According to Mahabaleshwar et al,<sup>[11]</sup> the mean duration of surgery was 34.37 minutes in the electrocautery group and 27.20 minutes in the ultrasonic dissection group ( $p = 0.001$ ). Zanghi et al,<sup>[14]</sup> reported in a retrospective study of 164 patients that the use of the Harmonic scalpel was associated with a significantly shorter mean operative time ( $35 \pm 10$  vs  $56 \pm 12$  min, $P < .001$ ); and Kandil et al,<sup>[15]</sup> reported in a prospective, randomized study that the use of the Harmonic scalpel alone for dissection and sealing in LC resulted in almost half the mean operative time ( $33.2 \pm 9.6$  vs.  $51.7 \pm 13.8$  min, $P = .001$ ). This benefit was thought to result from there being no requirement for laparoscopic instrument exchange and the absence of surgical smoke in the operative field from the use of the Harmonic scalpel.<sup>[16]</sup>

## CONCLUSION

Ultrasonic dissection is safe and effective for the hemostatic dissection, isolation, cutting and coagulation at the same time, which results in low temperature, decreased smoke/ lateral tissue damage, leading to less iatrogenic intraoperative complications during dissection of tissues by avoiding frequent instrumentation and a shorter duration of surgery in laparoscopic cholecystectomy. Therefore, we recommend the use of harmonic shear and can replace monopolar electrocautery for this purpose if available at operative theater.

## REFERENCES

- Rohatgi A, Widdison AL. An audit of cystic duct closure in laparoscopic cholecystectomies. *Surg Endosc.* 2006;20:875-77.
- Janssen IM, Swank DJ, Boonstra O, et al. Randomized clinical trial of ultrasonic versus electrocautery dissection of the gallbladder in laparoscopic cholecystectomy. *Br J Surg* 2003;90:799-803
- Diez J, Arozamena C, Gutierrez L, et al. Lost stones during laparoscopic surgery. *HPB Surg.* 1998;11:105-8.
- Peters JH, Gibbons GD, Innes JT, et al. Complications of laparoscopic cholecystectomy. *Surgery.* 1991;110:769-787.
- Schröder T, Hasselgren PO, Brackett K, et al. Techniques of liver resection: Comparison of suction knife, ultrasonic dissector and contact neodymium-YAG laser. *Arch Surg* 1987; 122: 1166- 1171.
- Gozen AS, Teber D, Rassweiler J. Principles and initial experience of a new device for dissection and hemostasis. *Minim Invasive Ther Allied Technol* 2007; 16:58-65.
- McCarus SD. Physiologic mechanism of the ultrasonically activated scalpel. *J Am Assoc Gynecol Laparosc.* 1996;3:601-08.
- Power C, Maguire D, McAnena OJ, et al. Use of the ultrasonic dissecting scalpel in laparoscopic cholecystectomy. *Surg Endosc* 2000;14:1070-3.
- Tsimoyiannis EC, Jabarin M, Glantzounis G, et al. Laparoscopic cholecystectomy using ultrasonically activated coagulating shears. *Surg Laparosc Endosc* 1998;8:421-4.
- Power C, Maguire D, McAnena OJ, et al. Use of the ultrasonic dissecting scalpel in laparoscopic cholecystectomy. *Surg Endosc.* 2000;14:1070-3.
- Mahabaleshwar V, Kaman L, Iqbal J and Singh R. Monopolar electrocautery versus ultrasonic dissection of the gallbladder from the gallbladder bed in laparoscopic cholecystectomy: a randomized controlled trial. *Can J Surg.* 2012;55(5):307-311
- Mahjoba NK, Tahirb E, Alsaffara S, Ahmad MM. Harmonic versus electrocautery in the dissection of gall bladder in laparoscopic cholecystectomy. *Ann Coll Med Mosul* 2013;39(2): 107-112
- Ramzanali SAA, Zia-ul-Islam, Shah SSH. Monopolar electrocautery versus ultrasonic dissection of the gallbladder from the gallbladder bed in laparoscopic cholecystectomy. *J Ayub Med Coll Abbottabad* 2013;25(3-4)
- Zanghi A, Cavallaro A, Di Mattia P, et al. Laparoscopic cholecystectomy: ultrasonic energy versus monopolar electrocautery. *Eur Rev Med Pharmacol Sci.* 2014;18(2 Suppl):54-59.
- Kandil T, El Nakeeb A, El Hefnawy E. Comparative study between clipless laparoscopic cholecystectomy by harmonic scalpel versus conventional method: a prospective randomized study. *J Gastrointest Surg.* 2010;14:323-328.
- Gelmini R, Franzoni C, Zona S, Andreotti A, Saviano M. Laparoscopic cholecystectomy with Harmonic scalpel. *JSLs.* 2010;14:14-19.