

Original Research Article

Comparative study of dissection of Calot's triangle and gallbladder using monopolar hook versus harmonic scalpel in laparoscopic cholecystectomy

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ABSTRACT

Background: Laparoscopic cholecystectomy (LC) using surgical electrocautery is considered to be the gold standard procedure for the treatment of uncomplicated cholecystitis and cholelithiasis. The objective of the current study was to evaluate the effectiveness and safety of the Harmonic scalpel, an advanced laparoscopic technique when compared to electrocautery.

Methods: From June, 2021 through December 2022, a total of 50 patients were randomly allocated to LC with a harmonic scalpel (group 2, 25 patients) or conventional monopolar electrocautery (group 1, 25 patients). The main outcome measures were gall bladder perforation during surgery (bile leakage), stone spillage, duration of surgery, hospital stay.

Results: The 2 groups were comparable with respect to baseline patient characteristics. When compared to conventional monopolar electrocautery, Gall bladder perforation during surgery (bile leakage) 12% vs. 8%, stone spillage 4% vs. 8%, duration of surgery 52.13 min vs. 54.89 min, hospital stay 2.09 days vs. 2.04 days.

Conclusions: LC using conventional monopolar electrocautery is as effective and safe as that with the harmonic scalpel, for treating uncomplicated cholecystitis and cholelithiasis.

Keywords: Laparoscopic cholecystectomy, Conventional cholecystectomy, Electrocautery, Harmonic scalpel, Morbidity, Operating time

INTRODUCTION

In compared to laparotomy, laparoscopic cholecystectomy (LC) is often regarded as the gold standard surgical treatment for symptomatic cholelithiasis and acute cholecystitis because it provides more definite and well-known benefits. A monopolar electrosurgical hook is typically used in the routine laparoscopic cholecystectomy in order to dissect the organ and clips are used to block the cystic duct and cystic artery.¹

Even while a laparoscopic cholecystectomy is generally regarded as a safe treatment, using a monopolar electric scalpel has some drawbacks, including a high risk of thermal burns and much more frequent postoperative biliary problems, like bile leakage caused by clip sliding.²

Injuries can also be caused by electrosurgical equipment due to the active electrode's insulation failing, direct connection with metal tools or tissue, and stray electrical currents. Alternative tools like ultrasonic scalpels have been further researched due to the hazards of patient damage. Regular electrocautery use results in more

smoke being produced, which obscures the operating area, lengthens the procedure, and increases the risk of gallbladder (GB) perforation.

More than ten years ago, the ultrasonically actuated scalpel (harmonic) was first used in a clinical setting. Its approach uses three complementary effects-coagulation, cutting, and cavitation-that can be achieved by applying ultrasound to tissues within the harmonic frequency range.³ Harmonic scalpel may offer the benefit of a quicker operating time by minimizing smoke, bloodless dissection in the GB bed, despite its high cost. There is, however, little supporting data for this advantage.⁴ The danger of tissue damage is decreased since the temperature obtained and the lateral energy spread are smaller than those discovered when the monopolar hook is employed.

The cystic artery and duct can be divided using the harmonic scalpel since it can seal luminal structures with a 5 mm thickness or less. In several research, it has been proven to be a successful method.⁶ However, pathologies such as fibrosed gall bladder, acute/chronic cholecystitis, and other conditions greatly alter the diameter and thickness of the cystic duct. Therefore, total clipless laparoscopic cholecystectomy is not an option due to the risk of bile leak. When compared to traditional laparoscopic cholecystectomy, using a harmonic scalpel for the entire procedure-aside from the clipping of the cystic duct-may offer the benefit of a shorter operating time, less bleeding, and fewer additional complications.

In order to compare harmonic scalpel, use in laparoscopic cholecystectomy to traditional laparoscopic cholecystectomy, the entire process was performed using harmonic scalpels, with the exception of clipping the cystic duct, which was accomplished with titanium clips.

Aim and objectives

The aims and objectives were to carry out a comparative study of LC using monopolar hook versus harmonic scalpel on the basis of following parameters between two groups: gall bladder perforation during surgery; stone spillage; duration of surgery; hospital stay.

METHODS

Study design

It was a cross sectional, randomized, observational and comparative study.

Source of data

Patients admitted with confirmed clinical and radiological diagnosis of cholelithiasis in General Surgery Department of SGT Medical College, Hospital and Research Institute, Budhera, Gurugram, Haryana were the source of data.

Sample size

A hospital based sequential sampling method was utilized.

50 patients with clinical and radiological diagnosis of cholelithiasis was studied.

25 patients underwent laparoscopic cholecystectomy using monopolar instrument vs. 25 patients underwent laparoscopic cholecystectomy using harmonic scalpel will be studied.

Study period

1st June 2021 to 31st December 2022 was the study period.

Inclusion criteria

Patients of all age groups admitted for gall stone disease undergoing laparoscopic cholecystectomy were included.

Exclusion criteria

Patients with choledocholithiasis; suspected gall bladder carcinoma; gall stone induced pancreatitis; acute cholecystitis; pregnancy were excluded.

Statistical analysis

The continuous variables will be presented as average mean and standard deviation (SD), while categorical variable as absolute number and percentage. The parametric data will be analysed by student's t test for unpaired samples, while non-parametric data will be analysed using Chi-square test or 'Fisher's-exact test. P value of <0.05 was taken as statistically significant

Ethical approval

The study was approved by the Institutional Ethics Committee.

Methodology

Group 1

Laparoscopic cholecystectomy using monopolar instrument

Patient was placed in reverse trendelenburg position and right up. Dissection of the omental adhesions to the GB was done.

A locking grasper held the fundus and retracted it superiorly and towards the right shoulder.

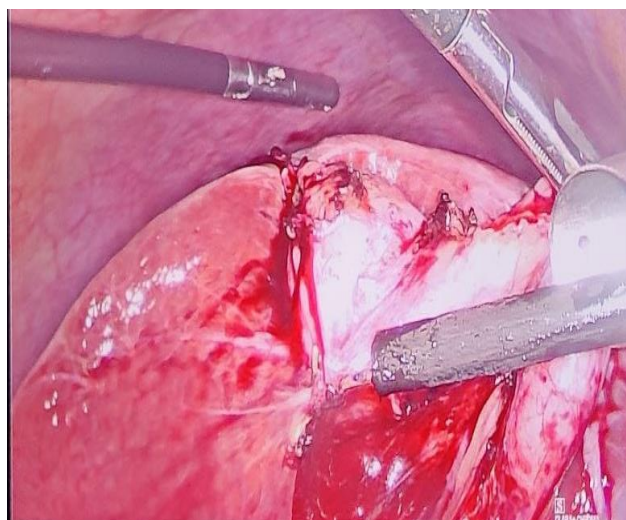


Figure 1: Dissection using monopolar hook.

Another grasper held the infundibulum and retracted it laterally, to the right. It separated the cystic duct from the common bile duct.

Dissection of the Calot's triangle with short bursts of electro cautery or blunt graspers was done.

Once the anterior and posterior dissection were complete and a window was created, and the cystic duct and artery were dissection in the Calot's triangle was done.

Apply clips to the cystic duct and artery and divided them.

Gall bladder was removed from the liver bed by using hook electrocautery.

Liver bed and cystic structures were checked for haemostasis.

Group 2

Laparoscopic cholecystectomy using harmonic scalpel

Patient was placed in reverse Trendelenburg position and right up.

Dissection of the omental adhesions to the GB was done.

A locking grasper held the fundus and retracted it superiorly and towards the right shoulder.

Another grasper held the infundibulum and retracted it laterally, to the right.

This separated the cystic duct from the common bile duct.

Dissection of Calot's triangle was done with harmonic scalpel.

It was ascertained that there are no calculi in the lumen of the cystic duct by milking the jaws of the harmonic scalpel.

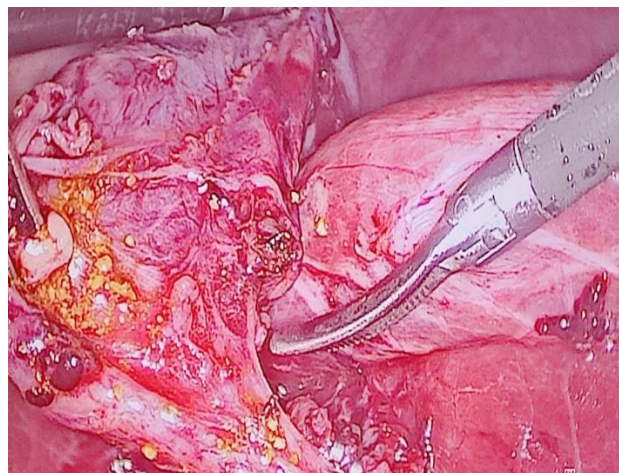


Figure 2: Dissection using harmonic scalpel.

The cystic duct was inserted between jaws of clip applicator at a safe distance from common bile duct to avoid damage to this structure.

Apply clips to the cystic duct and artery and divide them.

The cut ends of the cystic duct were checked for any bile leakage

Gall bladder was removed from the liver bed by using harmonic scalpel

Liver bed, and cystic structures were checked for haemostasis.

RESULTS

Females were comparatively more as compared to males in both the study groups. Maximum subjects were from the age group of 21-40 years in group 1 (56%) as well as group 2 (64%) followed by 41-60 years. Minimum subjects were from the age group of >60 years in both the groups. (Table 1 and 2).

In this study there was no bile duct injury in both the groups while stone spillage was 4% in group 1 and 8% in group 2 and gall bladder perforation in 12% and 8% in group 1 and group 2 (Table 3).

The mean time between the group1 and group 2 was of 52.13 and 54.89 min (Table 4).

There was no statistical difference in blood loss in both the groups (Table 5).

Post op pain and hospital stay (days) was almost same in both the groups (Table 6).

Table 1: Gender distribution among the study groups.

Gender	Monopolar hook		Harmonic scalpel	
	N	%	N	%
Male	9	36	8	32
Female	16	64	17	68
Total	25	100	25	100

Table 2: Age distribution among the study groups.

Age group (in years)	Monopolar Hook		Harmonic Scalpel	
	N	%	N	%
21-40	14	56	16	64
41-60	8	32	6	24
>60	3	12	3	12
Total	25	100	25	100

Table 3: Intraoperative findings among the study groups.

Findings	Monopolar hook		Harmonic scalpel	
	N	%	N	%
Adhesion with GB	4	16	3	12
Excessive fat over Calot's triangle	4	16	3	12
Gall bladder perforation	3	12	2	8
Bile duct injury	0	0	0	0
Stone spillage	1	4	2	8

Table 4: Comparison of operation time between two groups.

Group	Operation time (in min)		t test	P value
	Mean	SD		
Monopolar hook	52.13	7.08	1.14	0.11
Harmonic scalpel	54.89	6.41		

Table 5: Comparison of blood loss between two groups.

Group	Blood loss (in ml)		t test	P value
	Mean	SD		
Monopolar hook	13.47	8.78	1.41	0.09
Harmonic scalpel	14.32	7.93		

Table 6: Comparison of post-operative parameters between two groups.

Parameters	Monopolar hook		Harmonic scalpel		P value
	Mean	SD	Mean	SD	
Post-op pain	5.06	2.19	5.31	2.51	0.10
Duration of hospital stay (days)	2.09	0.52	2.04	0.32	0.79

*statistically significant.

DISCUSSION

For hemobiliary immobility in LC, the harmonic scalpel is a reliable and secure substitute for monopolar electrocautery.⁶⁻⁹ The shorter operating time of the harmonic scalpel in lc compared to traditional monopolar electrocautery is its main benefit. The shorter surgical time can be attributed to the harmonic scalpel's ability to dissect and close cystic arteries and ducts that are 4 to 5

mm in diameter without the need for clipping (reported by Huscer et al in 1999 and approved by the US Federal Food and Drug Administration in 2006).^{3,10}

A retrospective case series by Gelmini et al found that using the harmonic scalpel during laparoscopic surgery resulted in a much shorter median operating time than using traditional monopolar coagulation: 60 min (range, 20-205 min) vs. 85 min (45-150 min); p=0.001.¹

Additionally, Zanghi et al demonstrated that using the harmonic scalpel is related with a considerably reduced mean operating time in a retrospective examination of 164 patients.¹¹ The mean operational time for dissection and sealing in LC was reduced by almost half when using a harmonic scalpel alone. This advantage was believed to be brought about by the harmonic scalpel's lack of surgical smoke in the operating room and the elimination of the need for laparoscopic instrument interchange.¹²

However, Bulus et al reported that the use of any of these 3 surgical dissection or coagulation instruments was not related to a clinically significant increase or decrease in mean operative time in 60 patients who underwent LC with the harmonic scalpel, bipolar vessel sealing, and monopolar electrocautery.¹³ In addition, Catena et al shown that the mean operating times for the harmonic scalpel and electrocautery procedures for LC for acute cholecystitis were comparable.⁹ Variations in the study procedure, patient selection, surgical technique, surgeon expertise, and case volume may all contribute to this inconsistent operative time.

Our findings demonstrated that, in the hands of skilled laparoscopic surgeons, the use of conventional monopolar electrocautery was comparable to the Harmonic scalpel in terms of the operating time for uncomplicated LC. It should be highlighted that the cystic duct and artery were clipped shut in both the experimental and control groups. This outcome may be in contrast to that attained when surgeons directly seal the cystic duct and artery in the LC using the Harmonic scalpel.

Contrary to minimal energy transfer from ultrasonic vibration, LC using conventional monopolar electrocautery is well documented to be safe and associated with occasional iatrogenic injury, such as postoperative bleeding, bile duct damage, and bowel perforation. This was primarily because of the effect of collateral energy from electrocauterization. In comparison to traditional electrocautery, using the Harmonic scalpel may be associated with a lower incidence of conversion to open surgery and total surgical morbidity. However, neither statistically nor clinically, the lower risk was significant in these studies. Our study's findings confirmed that using traditional monopolar electrocautery did not significantly increase the likelihood of conversion or surgical morbidity as compared to using a Harmonic scalpel.

Laparoscopic dissection difficulty or gallbladder perforation caused by adhesion, uncontrollable bleeding, bile leak, missed coexisting bile duct stones, or gallbladder cancer on preoperative assessment and concurrent medical or surgical conditions were the main causes of LC conversion to laparotomy and other surgical morbidity.¹⁴ Therefore, as long as the aforementioned confounding or complicating circumstances are properly balanced or excluded, as in our uncomplicated patients scheduled for LC, the use of the harmonic scalpel or monopolar electrocautery does not significantly affect

conversion or surgical morbidity. However, using a harmonic scalpel had possible dangers because to its bulky tip's incapacity to perform delicate dissection and its straight tip's difficulties manipulating the tissue plane.

Apart from its good aesthetic outcome, LC has important well-documented advantages over an open operation, mostly due to the limited invasiveness of the port site incision in LC. These advantages included reduced postoperative discomfort and accelerated postoperative recovery. Possible causes of the post-LC pain included diaphragm stretching, residual pneumoperitoneum, and prolonged laparoscopic manipulation. The 2 procedures were comparable in terms of post-LC pain, the need for analgesics, and postoperative nausea and vomiting, most likely because both procedures took about the same amount of time to complete in our uncomplicated patients. Because of this, using the harmonic scalpel did not provide an extra advantage for postoperative recovery. A few restrictions applied to this investigation.

First off, while the randomization method was carried out by a central procedure and the patient data were collected and assessed by independent research workers, patient allocation was not made blind to the investigators. Second, because the authors have more experience using monopolar electrocautery, there may be an investigator bias when comparing the noninferiority of using Harmonic scalpel to conventional monopolar electrocautery. This bias was known as the learning curve effect, but it affected all general surgeons performing LC.

CONCLUSION

When compared to LC utilising traditional monopolar electrocautery in the hands of skilled surgeons, and the use of the harmonic scalpel for LC in the treatment of uncomplicated cases was associated with equal operative time, conversion risk, blood loss, and postoperative recovery. The harmonic scalpel's somewhat costly, especially in underfunded practices, was its main drawback.

Recommendations

When compared to monopolar electrocautery, the Harmonic scalpel is not recommended for use in uncomplicated LC due to its higher cost and insignificant benefits. In some patients with a high risk of surgical morbidity, the harmonic scalpel may be preferred.

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Ethical approval: The study was approved by the Institutional Ethics Committee

REFERENCES

1. Gelmini R, Franzoni C, Zona S, Andreotti A, Saviano M. Laparoscopic cholecystectomy scalpel. *JSLs*. 2010;14:14-9.

2. Hanazaki K, Igarashi J, Sodeyama H, Matsuda Y. Bile leak-age resulting from clip displacement of the cystic duct stump: a potential pitfall of laparoscopic cholecystectomy. *Surg Endosc.* 1999;13:168-71.
3. Huscher CGS, Lirici MM, DiPaola M. Laparoscopic cholecystectomy by ultrasonic dissection without cystic duct and artery ligation. *Surg Endosc.* 2003;17:442-51.
4. Mahabaleshwar V, Kaman L, Iqbal J, 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;55:307-11.
5. Gossot D, Buess G, Cuschieri A. Ultrasonic dissection for endoscopic surgery. *Surg Endosc.* 1999;13:412-7.
6. Kandil T, Nakeeb AE, Hefnawy EE. Comparative study between clipless laparoscopic cholecystectomy by harmonic scalpel versus conventional methods: a prospective randomized study. *J Gastrointest Surg.* 2010;14:323-8.
7. ElNakeeb A, Askar W, ElLithy R, Farid M. Clipless laparoscopic cholecystectomy using the Harmonic scalpel for cirrhotic patients: a prospective randomized study. *Surg Endosc.* 2010;24(10):2536-41.
8. Bessa SS, Abdel-Razek AH, Sharaan MA, Bassiouni AE, El-Khishen MA, El-Kayal ESA. Laparoscopic cholecystectomy in cirrhotics: a prospective randomized study comparing the conventional diathermy and the harmonic scalpel for gallbladder dissection. *J Laparoendosc Adv Surg Tech A.* 2011;21(1):1-5.
9. Catena F, DiSaverio S, Ansaloni L, Coccolini F, Sartelli M, Vallicelli C, et al. The HAC trial (harmonic for acute cholecystitis): a randomized, double-blind, controlled trial comparing the use of harmonic scalpel to monopolar diathermy for laparoscopic cholecystectomy in cases of acute cholecystitis. *World J Emerg Surg.* 2014;9(1):53.
10. Lachanas VA, Hajjioannou JK, Karatzias GT, Filios D, Koutsias S, Mourgelas C. Comparison of LigaSure vessel sealing system, harmonic scalpel, and cold knife tonsillectomy. *Otolaryngol Head Neck Surg.* 2007;137(3):385-9.
11. Zanghi A, Cavallaro A, DiMattia P, DiVita M, Cardì F, Piccolo G, et al. Laparoscopic cholecystectomy: ultrasonic energy versus monopolar electrosurgical energy. *Eur Rev Med Pharmacol Sci.* 2014;18(2):54-9.
12. Wills E, Crawford G. Clipless versus conventional laparoscopic cholecystectomy. *J Laparoendosc Adv Surg Tech A.* 2013;23(3):237-9.
13. Bulus H, Basar O, Tas A, Yavuz A, Akkoca M, Coskun A, et al. Evaluation of three instruments for laparoscopic cholecystectomy: harmonic scalpel, bipolar vessel sealer, and conventional technique. *Minerva Chir.* 2013;68(6):537-42.
14. Kama NA, Doganay M, Dolapci M, Reis E, Atli M, Kologlu M. Risk factors resulting in conversion of laparoscopic cholecystectomy to open surgery. *Surg Endosc.* 2001;15(9):965-8.

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