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Original Research Article

Comparative study to evaluate ultrasonic verses monopolar electrocautery dissection of gall bladder in laparoscopic cholecystectomy

Himanshi Mathur, Ashok Kumar Sharma*, Dheer Singh Kalwaniya

Department of Surgery, VMMC and Safdarjung Hospital, New Delhi, India

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***Correspondence:**
Dr. Ashok Kumar Sharma,
E-mail: drdsk85@gmail.com

ABSTRACT

Background: Gallstones are one of the most common routinely encountered surgical problem in the developed world. Laparoscopic cholecystectomy being the gold standard surgery for gall stones has been modified various times using different instruments in order to improve intraoperative and postoperative outcomes. The aim of the study was to see clinical outcomes of ultrasonic scalpel verses monopolar electrocautery in dissection of gall bladder in laparoscopic cholecystectomy.
Methods: A prospective randomized controlled study was done with total 100 patients in which 50 patients underwent laparoscopic cholecystectomy via ultrasonic scalpel while rest 50 patients were operated using monopolar electrocautery. The study was conducted for a period of eighteen months and clinical outcomes were studied in terms of operative time, frequency of lens cleaning, gall bladder perforation, biliary leak, common bile duct injury, bowel perforation and postoperative hospital stay.
Results: The two groups were comparable in terms of demographic profile considering age and sex distribution. However, there was a statistically significant reduction in operative time, frequency of lens cleaning and gall bladder perforation in group A (harmonic scalpel) as compared to group B (electrocautery).
Conclusions: Harmonic scalpel is not only a safe and effective instrument but also a reliable alternative to electrocautery. Even though the study revealed no significant difference in biliary leak, common bile duct injury, bowel perforation and postoperative hospital stay but it can significantly reduce operative time and incidence of gall bladder perforation. Thus, it can improve the operative course in laparoscopic cholecystectomy.

Keywords: Laparoscopic cholecystectomy, Monopolar electrocautery, Ultrasonic scalpel

INTRODUCTION

Gallstones are still one of the most common routinely encountered surgical problem in the developed world.[1] The aim of the study was to remove the diseased gall bladder completely and to ensure a patent channel for biliary drainage into the gastrointestinal tract. In this generation of minimally invasive approaches, laparoscopic cholecystectomy has become the 'gold standard' treatment modality for uncomplicated acute or chronic cholecystitis with cholelithiasis due to its minimal invasiveness and swift post-operative recovery.[2]

Inconventional laparoscopic cholecystectomy, especially for dissection and coagulation of Calot's triangle and gall bladder bed monopolar electrocautery is used, mainly using an electrosurgical hook and spatula.[3]

However, electrocautery produces too much surgical smoke and may hamper the vision and accuracy of dissection.[4] Also, there is risk of insulation failure of the active electrode and there might be direct coupling between the active electrode and tissue or metal instruments which can cause injury.[5] Furthermore, thermal side effects of electrocauterization can lead to

iatrogenic injury to adjacent solid organs and vessels such as small intestine and common bile duct.[6] Gall bladder perforation during dissection from the liver bed with spillage of bile and loss of stones in the peritoneal cavity is a common operative problem encountered during laparoscopic cholecystectomy.[3,4] Harmonic scalpel is used as an advanced, minimally invasive surgical device and it functions using ultrasonic energy, which is converted into mechanical energy at the active blade.[7]

The main mechanism is the delivery of high-grade frictional force at the active blade and the tissue is kept in proximity by inactive blade.[8] It enables synchronous cutting, cavitation and coagulation of dense tissue by a high frequency (55,500 Hz) vibration, which produces tissue stress and friction causing heat production and denaturation of tissue protein and minimizes the risk of collateral thermal damage to nearby tissues.[9] As a result of stress and friction, heat is generated which is below 80 degree Celsius, which stretches the tissue beyond its elastic limit and thus cutting it.[10] The incidence of gall bladder perforation and biliary spillage has also been reported to be low with ultrasonic dissection compared to monopolar electrocautery during laparoscopic cholecystectomy.[11,12] Therefore, this study was designed and conducted to observe the effect of ultrasonic dissection in laparoscopic cholecystectomy and to determine the incidence of gall bladder perforation, its intraoperative consequences and postoperative recovery.

METHODS

A randomized controlled single blinded study was conducted in the department of surgery, Vardhman Mahavir Medical College, Safdarjung Hospital, New Delhi. 50 patients in group A underwent harmonic scalpel dissection and 50 patients in group B underwent monopolar electrocautery dissection and were evaluated for a study period of 18 months (2018-2021). All patients between age 13-70 years, physical status class I or II according to ASA with diagnosis of chronic cholecystitis with cholelithiasis were included for laparoscopic cholecystectomy for gall bladder stone in elective operation theatre. Pregnant or lactating women, patients with pre-existing morbid obesity, ASA class III or IV, complicated intrahepatic or extrahepatic bile duct stone, complicated acute pancreatitis, history of previous upper abdomen open surgery and co-morbid conditions as chronic obstructive pulmonary diseases, coagulopathies were excluded from the study. Ultrasound abdomen confirmed cases of cholelithiasis were evaluated, after taking informed and written consent they were taken up for definitive surgery in the form of laparoscopic cholecystectomy with a standardized technique by the same surgical team each time.

Statistical methods

Categorical variables were presented in number and percentage (%) and continuous variables were presented as mean±SD and median. Normality of data was tested by Kolmogorov-Smirnov test. If the normality is rejected then non-parametric test was used.

Statistical tests were applied as follows- (a) quantitative variables were compared using unpaired t-test/Mann-Whitney test (when the data sets were not normally distributed) between the two groups; (b) qualitative variables were compared using McNemar Chi square test/Fisher's exact test. A p value of <0.05 was considered statistically significant. The data was entered in MS excel spreadsheet and analysis was done using Statistical Package for Social Sciences (SPSS) version 25.0.

Surgical technique

All the patients had received premedication, general anaesthesia with endotracheal intubation and intravenous antimicrobial prophylaxis as a routine surgical prophylaxis with ceftriaxone sodium. They were in supine position in reverse- trendelenburg position and inclined laterally to the left at an angle of 30 degrees. A nasogastric tube was placed at the beginning of the procedure. The standard 4- port technique was used to perform laparoscopic cholecystectomy. Pneumoperitoneum created using carbon dioxide insufflation and maintained at 12 mmHg. Calot's triangle and gall bladder bed were dissected with the harmonic scalpel (Harmonic Ace® +7) in the group A (Figure 1) or by laparoscopic monopolar electrocautery (LigaSure™) in group B (Figure 2). Titanium clips were used for closure and sealing of cystic duct and cystic artery in both groups. The gall bladder was mobilized from the gall bladder bed, and any obvious bleeding or biliary leakage was controlled. In both the groups subhepatic drain was placed if extensive dissection has been done.

All patients were instructed to resume ambulatory activities and intake of semiliquid diet on postoperative day 1 and were discharged if clinically found fit. Later, all the patients were followed up at the outpatient clinic for 30 days.

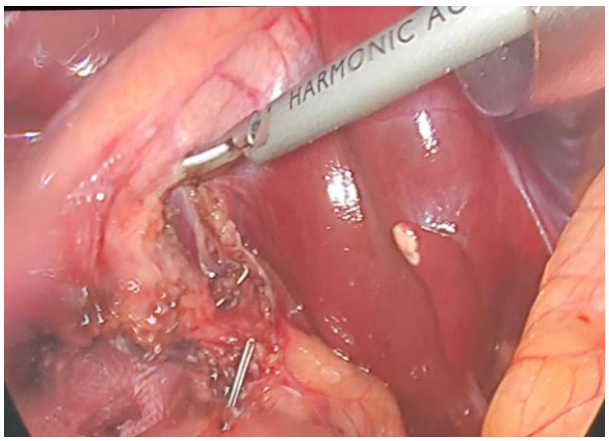

Figure 1: Dissection of gall bladder bed using harmonic scalpel in laparoscopic cholecystectomy.

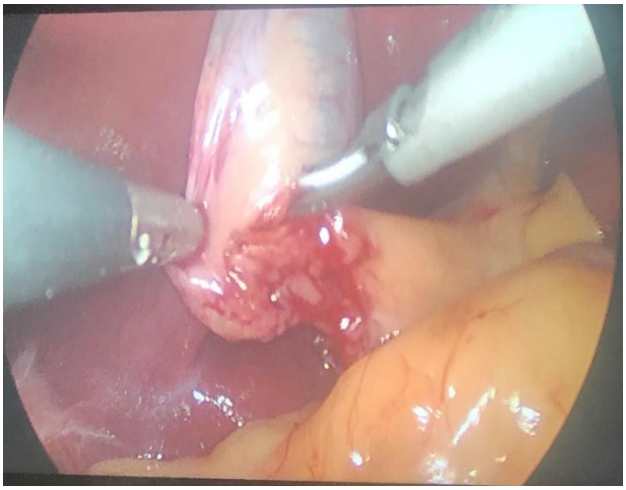

Figure 2: Dissection of gall bladder bed using monopolar cautery in laparoscopic cholecystectomy.

RESULTS

The mean±SD of age (years) in group A was 40.20±10.79 while in group B was 39.88±8.54. There was no significant difference between the groups in terms of age (years) (t=-0.164, p=0.870). There was no significant difference between the various groups in terms of distribution of age (χ^2=2.087, p=0.496). The majority of the patients in both the groups were females. In group A (harmonic scalpel) 76% were females and 24% were males while, in group B (electrocautery) 80% were females and 20% were males. The p value for sex distribution was found to be 0.112 which was statistically insignificant. The mean±SD of operative time (minutes) in the group A was 37.24±10.30 while in group B was 54.10±11.91. There was a significant difference between the 2 groups in terms of operative time (minutes) (W=2200.000, p≤0.001). The mean±SD of number of times lens cleaning done in group A was 2.06±0.82 and in group B was 4.22±1.31. There was a significant difference between the 2 groups in terms of number of times lens cleaning done (W=2264.500, p≤0.001). 4.0% of the participants in the group A had gall bladder perforation while 20% of the patients in group B had gall bladder perforation. There was a significant difference between the various groups in terms of distribution of gall bladder perforation (χ^2=6.061, p=0.014). 0.0% of the participants in the group A had biliary leak while 4.0% of the participants in group B had biliary leak. There was no significant difference between the various groups in terms of distribution of biliary leak (χ^2=2.041, p=0.495). None of the participants in either of the groups had Common bile duct and bowel injury. 2.0% of the participants in the group A and 2.0% of the participants in group B had drain (output nature: bile). There was no significant difference between the various groups in terms of distribution of drain output/nature (χ^2=0.000, p=1.000). The mean±SD of duration of hospital stay (days) in the group A was 1.08±0.27 while in group B was 1.20±0.70. Hence, there was no significant difference between the groups in terms of duration of hospital stay (days) (W=1258.000, p=0.912).

Table 1: Comparison of parameters in two groups.

Parameters	Method		P value
	Group A (electrocautery) (N=50) (%)	Group B (harmonic scalpel) (N=50) (%)	
Age (years)	39.88±8.54	40.20±10.79	0.870[1]
Age (years)			0.496[2]
<40	26 (52.0)	26 (52.0)	
40-60	24 (48.0)	22 (44.0)	
>60	0 (0.0)	2 (4.0)	
Operative time (minutes)* **	54.10±11.91	37.24±10.30	<0.001[3]
No. of times lens cleaning done* **	4.22±1.31	2.06±0.82	<0.001[3]
Gall bladder perforation (present)* **	10 (20.0)	2 (4.0)	0.014[4]
Biliary leak (present)	2 (4.0)	0 (0.0)	0.495[2]
Common bile duct injury (present)	0 (0.0)	0 (0.0)	1.000[4]
Bowel injury (present)	0 (0.0)	0 (0.0)	1.000[4]
Drain output/nature			1.000[2]
Bile	1 (2.0)	1 (2.0)	
Nil	49 (98.0)	49 (98.0)	
Duration of hospital stay (days)	1.20±0.70	1.08±0.27	0.912[3]

***Significant at p<0.05, 1: t-test, 2: Fisher's exact test, 3: Wilcoxon-Mann-Whitney U test, 4: Chi squared test.

DISCUSSION

The standard of care for patients with symptomatic cholelithiasis is laparoscopic cholecystectomy.[13,14] Conventionally monopolar electrocautery has been used but recently, harmonic scalpel has been used as an alternative cutting method for laparoscopic cholecystectomy.[15,16] It is known to produce reduced smoke and minimal blood loss and less chances of Gall bladder perforation, common bile duct injury and bowel injury.[17,18] In our study, the mean age in group A was 40.2±10.79 while in group B was 39.88±8.54. There was

no significant difference in distribution of age (p=0.870) similar to the study conducted by Mahabaleswar et al (45.30±9.32 vs 47.36±10.42; p=0.55).[15]

In the studies conducted by Jain et al (64.7±13.74 vs 50±9.36; p=0.001) and Kandil et al (61.88±16.17 vs 52.14±9.8; p<0.0001) operating time was significantly less in the harmonic group.[12,18] In our study as well, we found a significant difference in operating times between the two groups (54.10±11.91 vs 37.24±10.30; p≤0.001). In our study also, we found a significant difference between two methods in terms of operative time with a p value of <0.001, time being lower in harmonic group.

A commonly encountered problem is bleeding from the liver bed for which, the harmonic scalpel has benefit of stopping the bleeding without causing smoke.[17] The harmonic scalpel, being a multifunctional instrument replaces four instruments namely, the dissector, clip applicator, electrosurgical hook/spatula and scissors. Hence, there is no requirement of changing instruments frequently, and this reduces time.

No smoke is emitted when harmonic scalpel is used and thus, camera lens does not require to be cleaned frequently, this saves time.[13,14,18] In our study, we found a significant reduction in number of times lens was cleaned in group A (p≤0.001) leading to reduction in operating time similar to the study conducted by Mahabaleswar et al who found reduced number of times lens cleaning done in harmonic group (p=0.015).[15]

One of the commonly encountered intraoperative complications during laparoscopic cholecystectomy is gall bladder perforation. The harmonic scalpel decreases the lateral thermal spread and reduces the risk of gall bladder perforation. Kandil et al in their study, showed that the risk of gall bladder perforation was significantly higher in the electrocautery group as compared to the harmonic group (18.6% vs 7.1% respectively; p=0.04).[18] Conversely, Mukesh et al in their study found that, there was no significant risk in gall bladder perforation.[16] In our study, ten patients (20%) in the electrocautery group had gall bladder perforation while two patients (4%) in the harmonic group had gall bladder perforation; the difference was significant with a p value of 0.014.

In our study, none of the patients had any intraoperative complications like bleeding, bile duct injury, etc. Laparoscopic cholecystectomy using harmonic scalpel as compared with conventional monopolar electrocautery is recorded to be safer and associated with infrequent iatrogenic injury, such as postoperative bleeding, common bile duct damage and bowel perforation, mainly because of the effect of collateral damage from electrocauterization, contrary to minimal energy transfer while using ultrasonic vibration.[15,19]

The overall hospital stay in harmonic scalpel is less than electrocautery group in study conducted by Janssen et al.[14] However, in our study we found no significant difference in postoperative hospital stay associated with the two methods (p=0.912).

CONCLUSION

The study was conducted prospectively to compare clinical outcomes of using harmonic scalpel as compared to electrocautery in gall bladder bed dissection in laparoscopic cholecystectomy. According to our study, it has been observed that age distribution and sex was comparable in both groups.

The average operating time in group A was 37.24±10.30 while in group B was higher 54.10±11.91. The average number of times lens cleaning done was 2.06±0.82 in group A while in group B it was 4.22±1.31. The incidence of gall bladder perforation in group A was 4% as compared to 20% in group B. Thus, it was observed that there was a significant difference in operating time, number of times lens cleaning and incidence of gall bladder perforation between the two groups, showing harmonic scalpel as a better alternative for electrocautery. However, the two groups were comparable in terms of biliary leak (p=0.0495), common bile duct injury, bowel perforation, drain output/nature (p=1.0) and post-operative hospital stay (p=0.912).

It was concluded in our study that harmonic scalpel has a significant advantage over electrocautery in terms of operative time and incidence of gall bladder perforation. Further randomized trials are required to prove a definite advantage of the harmonic scalpel over conventional electrocautery for laparoscopic cholecystectomy.

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