



“COMPARATIVE STUDY OF USE OF MONOPOLAR ELECTROCAUTERY VERSUS HARMONIC SCALPEL IN LAPAROSCOPIC CHOLECYSTECTOMY

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ABSTRACT

Background- Harmonic scalpel (HS) has been suggested as an alternative to monopolar electrocautery (EC) in laparoscopic cholecystectomy because it inflicts less tissue damage and may have a lower incidence of gallbladder perforation.

Aims and objectives- To compare the use of EC and HS in laparoscopic cholecystectomy by the following factors- Duration of surgery, Gall bladder perforation, Bile leak, Stone spillage.

Methods- Patients with symptomatic gall stone disease were randomly assigned to electrocautery dissection (ECD) or harmonic scalpel dissection (HSD). The groups were comparable with respect to demographic characteristics, symptomatology, previous abdominal surgeries, comorbidities, preoperative ultrasonography findings and intraoperative complications. Both groups were compared for incidence of gallbladder perforation during dissection, bile leak, stone spillage and duration of surgery.

Results- Out of 60 patients, the overall incidence of gallbladder perforation was 28.3% (40% in the electrocautery vs 16.7% in the harmonic dissection group, $p=0.045$). Bile leak occurred in 40.0% of patients in the electrocautery group and 16.7% of patients in the harmonic dissection group ($p=0.045$). And duration of surgery ($p=0.001$) was longer in the ECD than the HSD group. There were no statistical difference in stone spillage between the groups ($p=0.62$).

Conclusion- HSD is safe and effective, and it improves the operative course if laparoscopic cholecystectomy by reducing the incidence of gallbladder perforation and duration of surgery.

KEYWORDS : laparoscopic cholecystectomy, harmonics, monopolar electrocautery, HSD- harmonic scalpel dissection, ECD- electrocautery dissection.

Introduction

Gall stone disease is one of the most common problem affecting the digestive tract. Autopsy reports have shown a prevalence of gallstones from 11%-36%. The prevalence of gallstone is related to many factors including age, gender, and ethnic background. Conditions that predispose development of gallstones are - obesity, pregnancy, dietary factors, Crohn's disease, terminal ileal resection, gastric surgery, hereditary spherocytosis, sickle cell disease and thalassemia are all associated with an increased risk of developing gallstones. Women are three times more likely to develop gallstone than men and first degree relatives of friends with gall stones have a two fold greater prevalence.

The modern era of laparoscopic surgery has evoked remarkable changes in approaches to surgical diseases. The trend toward minimal access surgery (MAS) has prompted general surgeons to scrutinize nearly all operations for possible conversion to laparoscopic techniques. Laparoscopic cholecystectomy is the “gold standard” for treatment of symptomatic gallstone disease. 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. The incidence of gallbladder perforation during laparoscopic cholecystectomy has been reported to be 20%–40%. During surgery, gallbladder perforation with spillage of bile and loss of stones disrupts the flow of surgery and prolongs its duration. At present, EC is the main cutting method used for gallbladder dissection from the liver bed. It is associated with local thermal and distant tissue damage, which might cause inadvertent perforation of the gallbladder during gallbladder bed dissection. HS generates less thermal injury, produces a smaller zone of tissue damage and more precise dissection, and has been suggested as an alternative to MEC in laparoscopic cholecystectomy. The incidence of gallbladder perforation also has been reported to be low with ultrasonic dissection compared to EC during laparoscopic cholecystectomy. HSD of the gallbladder bed during laparoscopic cholecystectomy has the potential to improve the quality of surgery by decreasing the incidence of gallbladder perforation and its intraoperative consequences. The present study was designed and

conducted to observe the effect of ultrasonic dissection in laparoscopic cholecystectomy and to determine the incidence of gallbladder perforation and its intraoperative consequences.

Aims and Objectives of the study

To compare the use of EC and HS in laparoscopic cholecystectomy by the following factors.

1. Duration of surgery 2. Gall bladder perforation 3. Bile leak 4. Stone spillage.

Methodology

SAMPLE SIZE: 60 patients with symptomatic cholelithiasis

INCLUSION CRITERIA:

1. Symptomatic cholelithiasis

EXCLUSION CRITERIA:

1. Asymptomatic cholelithiasis 2. Patients with severe comorbidities.

STUDY METHODOLOGY: Patients who satisfy the inclusion criteria are taken up for surgery after history taking, meticulous examination and basic pre-operative investigations. 30 cases underwent laparoscopic cholecystectomy using electrocautery. 30 cases underwent laparoscopic cholecystectomy using harmonic scalpel. Data documented are the intra operative gall bladder perforation, bile leak, stone spillage, duration of the surgery.

Statistical method

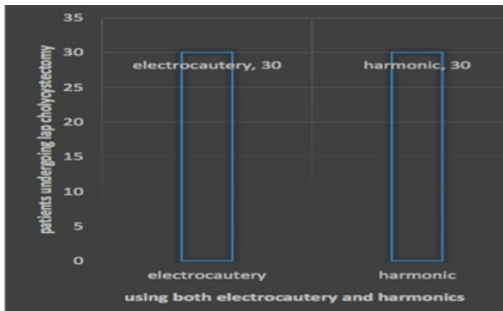
The statistical analysis was carried out using Statistical Package for Social Sciences software version 15.0 for Windows (SPSS Inc.). All quantitative variables were estimated using measures of central location (mean, median) and measures of dispersion (standard deviation and standard error). Normality of data was checked using measures of skewness and Kolmogorov–Smirnov tests of normality. For normally distributed data, we compared means using the Student t test for both groups. For skewed data, we used the

Mann–Whitney U test. Qualitative or categorical variables were described as frequencies and proportions. Proportions were compared using the χ^2 or Fisher exact test as applicable. The risk of gallbladder perforation in the presence of complicating factors was also estimated by calculating odds ratios. Values of $p < 0.05$ were considered to be significant.

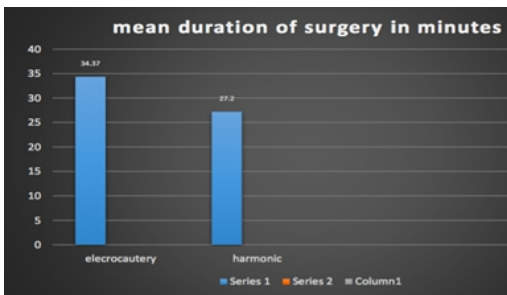
Results

Out of 30 cases in each group, gallbladder perforation occurred in 12 (40.0%) patients in the ECD group and 5 (16.7%) patients in the HSD group. Bile leak was noted in all patients who had gallbladder perforation (40.0% in the ED group vs 16.7% in the HSD group), with an overall incidence of 28.3% ($p = 0.045$; Table 3). Stone spillage was noted in 7 patients in the electrocautery group and 2 patients in the ultrasonic dissection group. The mean number of times that lens cleaning (extracorporeal and intracorporeal) was required per patient was twice in the ECD group and once in the ultrasonic dissection group ($p = 0.004$). The mean duration of surgery in was 34.37 minutes the electrocautery group and 27.20 minutes in the ultrasonic dissection group ($p = 0.001$). Ultrasonic dissection reduced the requirement of lens cleaning and the duration of surgery. Of the 21 patients who experienced complications, 13 (61.9%) sustained gallbladder perforation during the procedure. Analysis revealed an odds ratio of 14.23 for complications, which reflected the risk of perforation. It showed that there was a 14.23 times greater risk of gallbladder rupture in the presence of complications.

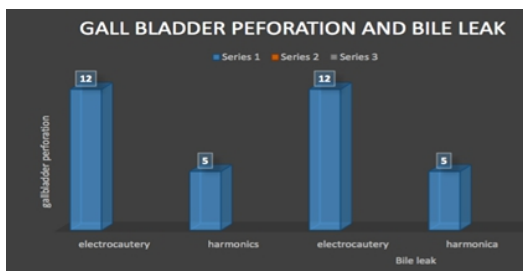
There was no bile duct injury, bleeding or bile leak from gallbladder fossa noted during surgery or the postoperative period. No patients required conversion to open surgery, and the only postoperative complications that occurred were port site infections in 2 patients.



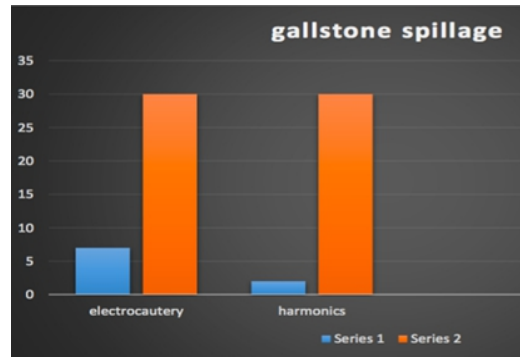
Graph 1: No of patients undergoing laparoscopic cholecystectomy using EC and HS



Graph 2: Mean duration of surgery in minutes



Graph 3: Gall bladder perforation and bile leak



Graph 4: stone spillage

Characteristics	Electrocautery n=30	Harmonics n=30	p value
Age, mean yr	47.36	45.3	0.55
Body mass index, mean	26.38	27.53	0.27
Presenting symptoms			
Heart burn	13	15	0.60
Pain abdomen	13	20	0.07
Dyspepsia	23	23	>0.99
History of gall stone pancreatitis	2	1	0.55
Sex, male:female	1:1.5	1:2.75	0.27
Previous abdominal surgeries	2	3	0.64
Intraoperative complications	9	12	0.42

Table 1: Demographic and clinical and complications among patients randomly assigned to electrocautery and harmonic dissection

Findings	Electrocautery n=30	Harmonic n=30	p value
Distended gallbladder	19	19	>0.99
Gallbladder wall thickness >3mm	7	2	0.07
Pericholecystic lucency	2	2	>0.99
Single calculus	8	6	0.54
Multiple calculi	13	18	0.20
Sludge	9	6	0.37
Stone size >1 cm	3	3	>0.99
Common bile duct diameter >6mm	4	6	0.49

Table 2: Comparison of preoperative ultrasonography findings between the electrocautery and harmonic dissection groups

Outcome	Electrocautery n=30	Harmonic n=30	p value
Primary			
Gall bladder perforations	12(40.0)	5(16.7)	0.045
Secondary			
Bile leak	12(40.0)	5(16.7)	0.045
Stone spillage	7(23.3)	2(6.7)	0.62
Duration of surgery, min.	34.37	27.20	0.001

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

DISCUSSION

The use of MEC is often associated with inadvertent tissue injury, as it generates intense collateral heat leading to tissue necrosis and

ischemia. Most electrocautery injuries go unrecognized during surgery or present late. But injury such as gallbladder perforation during laparoscopic cholecystectomy may greatly hinder the surgical procedure by leading to inevitable spillage of bile and stones into the peritoneal cavity. This may prolong the surgical procedure and have serious consequences. Unlike MEC, ultrasonic dissection instrumentation denatures protein by means of ultrasonic vibrations at a frequency of 55, 500 Hz with a vibratory excursion of 50–100 μm. The vibration transfers mechanical energy to the tissue, resulting in simultaneous cutting and coagulation. The vibrating ultrasonic dissector produces a coagulum of denatured protein and blood clot that occludes adjacent blood vessels and reduces bleeding. Vibration of the dissector scalpel blade does not generate as much heat as monopolar cautery or laser cautery, and the vibration in potential spaces results in cavitations, which may facilitate tissue dissection. smoke is not generated, only microaromized water droplets are produced, and no electric current is detected in the surgical field, therefore, this cutting method is also safe for use in patients with implanted pacemakers The mist produced by the harmonic scalpel is rapidly absorbed by the peritoneal surface, and it does not require suctioning or releasing the smoke that is produced during monopolar electrocautery dissection. Gallbladder perforation is reported to be the most frequent complication occurring intraoperatively during laparoscopic cholecystectomy. Perforation occurs in 13%– 50% of patients who undergo laparoscopic cholecystectomy, and in 10%–40% of these patients, bile leakage and stone spillage are present. Laceration due to grasper traction and electrocautery dissection is the most common mechanism of gallbladder rupture during laparoscopic cholecystectomy. The overall incidence of gallbladder perforation in our study was 28.3% and differed significantly between the 2 groups (40.0% in the electrocautery group vs. 16.7% in the ultrasonic dissection group, $p = 0.045$). There was a 23.3% reduction in the perforation rate with the harmonic dissector. Reduction of gallbladder perforation during laparoscopic cholecystectomy using the ultrasonic dissector has also been reported in other studies. Bile leak was noted in all patients who had gallbladder perforation, but the incidence of stone spillage was 58.3% in the electrocautery group and 40.0% in the ultrasonic dissection group, which was not significant ($p = 0.62$). Janssen and colleagues⁶ reported that the gallbladder perforation with stone spillage was 6 times higher in the electrocautery group than the ultrasonic dissection group. However, even if perforation occurred, stone spillage could still be prevented by quickly occluding the perforated site of the gallbladder with a grasper. The incidence of gallbladder perforation during laparoscopic cholecystectomy has been reported more often in patients with complications, such as acute cholecystitis, fibrotic gallbladder and dense adhesions in the Calot triangle. Ultrasonic dissection is the technique of choice for gallbladder dissection in patients with complications. Our study revealed a 14.23 times greater risk of gallbladder rupture in the presence of complications, and gallbladder perforation occurred in all patients with complications in the electrocautery group and in 33.3% of patients in the harmonic dissection group. This observation suggests that the ultrasonic dissector is a better device, especially in patients with complicated gallbladder disease. In our study, 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 lens cleaning was required per patient was twice in the electrocautery group and once in the ultrasonic dissection group ($p = 0.004$). The number of lens cleanings is very subjective, but the very need for lens cleaning (extracorporeal and intracorporeal) suggests the degree of difficulty and the duration of the surgical procedure. Duration of surgery in our study was significantly shorter in the ultrasonic dissection group than the electrocautery group (27.20 min v. 34.37 min, $p = 0.001$). The use of the ultrasonic dissector in laparoscopic cholecystectomy provides a superior alternative to monopolar electrocautery, as it is associated with shorter duration of surgery Shorter mean duration of surgery in the ultrasonic dissection group may be attributed to several factors. Late injury to the bile duct observed in 2 patients in

monopolar electrocautery group. Lens clearing was more with electrocautery group than harmonic group The Harmonic Ace is a multifunctional instrument; it replaces 4 instruments routinely used in laparoscopic cholecystectomy: namely, the dissector, clip applicator, scissors and electrosurgical hook or spatula. Finally, the activation of the ultrasonic dissector does not produce smoke and allows the surgeon to work in a clear operative field throughout the operation. Cost is a concern with the routine use of a Harmonic scalpel in laparoscopic cholecystectomy. Ours is a fully government-funded hospital, and the cost of all surgical procedures is subsidized, so there is no difference in the cost for use of Harmonic scalpel and monopolar cautery dissection. Otherwise, Harmonic scalpel use will be more costly.

	Our study		J Ayub Med Coll Abbottabad 2013;25(3-5):16-8	
	Harmonics	electrocautery	Harmonics	Electrocautery
Operative time(min)	27.20	34.37	40-70	50-100
Gall bladder perforation	5	12	2	3
Bile leakage	5	12	2	3
Stone spillage	2	7	0	4

Table 4- Table showing comparison between our study and others

So this infers that overall intraoperative complications, and duration of surgery is more with the usage of MEC compared to harmonic in laparoscopic cholecystectomy.

CONCLUSION

Ultrasonic dissection is safe and effective, and it improves the operative course of laparoscopic cholecystectomy. 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. This being a small study, there is a greater chance of type-II statistical error in the results, so our results must be confirmed by conducting a larger, multicentric randomized trial.

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