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Study to Compare Monopolar Electrocautery Versus Ultrasonic Dissection of Gall Bladder in Laparoscopic Cholecystectomy

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Abstract
The aim of the present study was to compare monopolar electrocautery versus ultrasonic dissection of gall bladder in laparoscopic cholecystectomy. A prospective randomized controlled trial within the duration of 1 year was conducted in the Department of General Surgery after taking clearance from Ethical committee. It included 50 patients undergoing laparoscopic cholecystectomy. Age distribution was similar among groups. Sex distribution had an insignificant p value. Operational time differed significantly across groups. The two groups differed significantly in lens cleaning frequency. Gall bladder perforation distribution differed significantly between groups. Biliary leak distribution was similar among groups. The drain output/nature distribution was similar among groups. Thus, hospital stay days were similar across groups. In conclusion, ultrasonic harmonic laparoscopic gallbladder stone dissection is safer than monopolar electrocautery.

INTRODUCTION

Laparoscopic cholecystectomy is considered the most effective and reliable surgical procedure for treating gallstone disease that causes symptoms. The conventional laparoscopic cholecystectomy is often conducted with specialised equipment. In most medical facilities, high-frequency Monopolar technology is often used for gallbladder dissection, using the electrosurgical hook, spatula and/or scissors. Simple metal clips are often used to establish closure of both the cystic duct and artery by occlusion[1]. Various energy sources, such as electrocautery, carbon dioxide (CO2) laser and ultrasonic scalpel, have been used in laparoscopic surgery to cut and coagulate tissues. Currently, Monopolar electrocautery is the primary surgical technique used for dissecting the gallbladder from the liver bed. However, it is linked to both nearby heat and distant tissue harm, which might potentially result in unintended puncturing of the gallbladder during the dissection of the gallbladder bed[2].

A frequent complication during laparoscopic cholecystectomy is the rupture of the gallbladder while separating it from the liver, resulting in the release of bile and loss of stones into the abdominal cavity. This issue often interrupts the surgical procedure and causes it to take longer[3].

The prevalence of gallbladder perforation after laparoscopic cholecystectomy has been shown to range from 20%-40%[4]. To provide a secure, efficient, and meticulous removal of the gallbladder during laparoscopic cholecystectomy, many surgical instruments have been created with the goal of minimising both intraoperative and postoperative problems[5]. Currently, with electrocautery, a range of ultrasonic scalpel, water jet dissectors, laser systems, and specifically designed suction devices are being used. Through the use of different techniques, all of these types of equipment may achieve full control of bleeding during dissection[6].

The ultrasonically activated scalpel, also known as the Harmonic scalpel, was developed as a secure substitute for electrocautery in order to provide controlled tissue dissection while ensuring haemostasis. The principal use of the Harmonic scalpel in laparoscopic cholecystectomy is for the purpose of dividing the cystic artery and performing liver bed dissection. This cutting-edge technique uses ultrasound in the harmonic frequency range to interact with tissues, resulting in two effects: ultrasonic coagulation and cavitational effects caused by a fast-vibrating blade that comes into contact with different tissues[7]. The thermal energy produced due to tension and friction remains below 80 degrees Celsius. Consequently, the occurrence of tissue charring and desiccation due to moisture loss is reduced to a minimum. The cavitational or cutting effect is generated by a blade with a moderately sharp edge oscillating at a frequency of 55,500 hertz across a distance of 60-100 micrometres. The process involves exceeding the tissue's elastic limit and disrupting molecular connections, resulting in its cutting. The use of the Harmonic scalpel offers a superior option to conventional electrocautery due to its ability to reduce temperatures, smoke, lateral tissue damage and enable more exact dissection[8].

The objective of this research was to evaluate the use of monopolar electrocautery with ultrasonic dissection in laparoscopic cholecystectomy for the removal of the gall bladder.

MATERIAL AND METHODS

A one-year prospective randomized controlled experiment was done at the Department of General Surgery after obtaining approval from the Ethical committee. The study included a cohort of 70 individuals who were having laparoscopic cholecystectomy.

Inclusion Criteria:

- Adult patients with uncomplicated acute or chronic cholecystitis with cholelithiasis disease who were eligible for laparoscopic cholecystectomy.

Exclusion Criteria:

- Patients with common bile duct stones, suspicion of gallbladder malignancy based on ultrasonography and subsequent computed tomography findings and patients not fit for laparoscopic surgery were excluded.

Patients were randomly assigned into two groups using the envelope method to either monopolar electrocautery or ultrasonic dissection just before the operation.

Group I: In the ultrasonic dissection group, dissection of the gallbladder was performed using Harmonic Ace curved shears.

Group II: Patients undergoing laparoscopic cholecystectomy in whom gall bladder dissection was done by monopolar electrocautery.

All patients received laparoscopic cholecystectomy using one of the allocated dissection techniques, as determined by random assignment and the procedure was successful for all of them. The preoperative data of each patient, including age, sex, body mass index (BMI), presenting symptoms, comorbidities, past abdominal procedures and ultrasound findings, were recorded. The condition was further aggravated by the

presence of acute cholecystitis, a gallbladder that had undergone shrinkage and fibrosis, gallstones lodged in the neck of the gallbladder and strong adhesions between the gallbladder and adjacent tissues. These traits were observed during laparoscopy. The primary objective of this research was to ascertain the frequency of inadvertent puncture of the gallbladder during the procedure of its detachment from the liver. Additional parameters that were assessed were the occurrence of bile leakage from the pierced site, the inadvertent release of gallstones into the abdominal cavity, the quantity and technique used for cleaning the surgical tools and the overall duration of the operation from commencement to conclusion. In addition, we performed an evaluation to determine the probability of gallbladder perforation in the presence of complicating factors.

Before commencing the treatment, all patients received prophylactic antibiotics and underwent general anaesthesia. The research included individuals who had laparoscopic cholecystectomy, a surgical technique performed by skilled consultants. The process adhered to a standardized methodology.

Statistical Analysis: The statistical analysis was carried out using Statistical Package for Social Sciences software version 15.0 for Windows (SPSS Inc. All statistical tests were 2-sided and performed at a significance level of p-value = 0.05.

RESULTS AND DISCUSSIONS

Group A had a mean age of 39.73±7.43 years, whereas group B had 41.33±11.77 years. No significant age difference existed across groups. Age distribution was similar among groups. Most patients in both groups were women. In group B (harmonic scalpel), 23 were female and 12 were male; in group A (electro-cautery), 25 were female and 10 were male. Sex distribution had an insignificant p value. Group A had a mean operational time of 53.17±13.77 minutes, whereas group B had 39.31±11.22 minutes. Operational time differed significantly across groups. The mean ± SD of lens cleaning frequency in group A was 4.12±1.36 and in group B, 2.10±0.86. The two groups differed significantly in lens cleaning frequency. 7 individuals in group A and 2 in group B suffered gall bladder perforation. Gall bladder perforation distribution differed significantly between groups. Two A group members experienced biliary leaks. Biliary leak distribution was similar among groups. 2 people in groups A and B had bile drains. The drain output/nature distribution was similar among groups. Group A had a mean ± SD hospital stay length of 1.17±0.73 days, whereas group B had 1.07±0.25. Thus, hospital stay days were similar across groups.

Symptomatic Cholelithiasis is a prevalent condition, occurring in 10-25% of the population[9-10]. Laparoscopic cholecystectomy is considered the most effective and reliable method for treating gallstone disease that causes symptoms. It offers the benefits of reduced post-operative discomfort, improved cosmetic outcomes, shorter hospitalisation, earlier resumption of employment and cost-effectiveness[11]. While laparoscopic cholecystectomy is generally regarded as a safe surgical technique, it often presents issues such as local thermal burns and distant tissue damage resulting from the use of monopolar electrocautery. The occurrence of gall bladder perforation during Laparoscopic cholecystectomy, when dissecting the gall bladder from the liver bed with monopolar electrocautery, is estimated to be between 20-40%. The perforation of the gall bladder and the leakage of bile and stones impede the progress of the operation and extend its length[4-12].

The average age (in years) in group A was 39.73±7.43 years, whereas in group B it was 41.33±11.77 years. There was no notable disparity in age (measured in years) between the groups. There was no discernible disparity among the different groups in terms of age distribution. Females constituted the majority of patients in both groups. Group B, which used the harmonic scalpel, consisted of 23 females and 12 men. In contrast, Group A, which used electrocautery, consisted of 25 females and 10 males. The p value for sex distribution was determined to be statistically non-significant. The duration of the operation (in minutes) in group A was 53.17±13.77, while in group B it was 39.31±11.22. There was a notable disparity in the operational time (measured in minutes) between the two groups. The Harmonic Ace is a versatile device that serves as a substitute for four commonly used devices in laparoscopic cholecystectomy: namely, the dissector, clip applier, scissors, and electrosurgical hook or spatula. Ultimately, the initiation of the ultrasonic dissector does not generate smoke and enables the surgeon to operate in a visually unobstructed surgical area for the whole procedures[13].

The number of times lens cleaning was performed in group A was 4.12±1.36, whereas in group B it was 2.10±0.86. There was a notable disparity between the two groups in terms of the frequency of lens cleaning performed. Out of the participants in group A, 7 had gall bladder perforation, while in group B, 2 individuals had gall bladder perforation. There was a notable disparity among the different groups in regards to the distribution of gall bladder perforation. Two individuals in group A had biliary leakage. There was no notable disparity among the different groups for the distribution of biliary leak. Two people in both group A and group B had drainage, namely bile. There was no notable disparity among the different groups regarding the distribution of drain output or its characteristics. The length of hospital stay (in days) in group A was

Table 1: Comparison of parameters in two groups

	Method		
Parameters	**Group A (electrocautery)(N=35)**	**Group B (harmonic scalpel)(N=35)**	**p-value**
	Gender		
Male	10	12	0.120
Female	25	23	
	Age in years		
<40	18	19	0.175
40-60	17	15	
>60	0	1	
Mean ± SD	39.73±7.43	41.33±11.77	0.812
Operative time (minutes)	53.17±13.77	39.31±11.22	<0.001
No. of times lens cleaning done	4.12±1.36	2.10±0.86	<0.001
Gall bladder perforation (present)	7	2	0.017
Biliary leak (present)	2	0	0.484
Common bile duct injury (present)	0	0	1.000
Bowel injury (present)	0	0	1.000
Drain output/nature			1.000
Bile	2	2	
Nil	33	33	
Duration of hospital stay (days)	1.17±0.73	1.07±0.25	0.880

1.17±0.73, where as in group B it was 1.07±0.25. Therefore, there was no substantial disparity between the groups in relation to the length of hospitalization (measured in days). Ramzanali[14] did research on 92 patients, including 46 individuals in each group. They found that the incidence of gallbladder perforation and stone leakage was lower in the Harmonic group compared to the Electrocautery group. The gallbladder was punctured in two instances during Harmonic Scalpel dissection, compared to three instances during Electrocautery dissection. In addition, there were no instances of stone spilling seen in the situations when the Harmonic Scalpel was used for dissection. However, in the cases where mono-polar Electrocautery was used for dissection, there were 4 reported instances of stone spillage. Jain[15] saw a substantial reduction in post-operative discomfort in the harmonic shear group. This may be related to a decrease in the production of inflammatory mediators, which occurs due to a reduction in both tissue and nerve damage in the surrounding area. Additionally, the shorter length of surgery directly impacts the duration and intensity of traction on blood vessels and nerves, resulting in a reduced duration of peritoneal distension.

Zanghi[16] conducted a retrospective study involving 164 patients and found that using the Harmonic scalpel resulted in a significantly shorter average operative time (35± 10 vs 56 ± 12 min, P < .001). Similarly, Kandil[17] conducted a prospective, randomized study and found that using the Harmonic scalpel exclusively for dissection and sealing in laparoscopic cholecystectomy resulted in almost half the average operative time (33.2 ± 9.6 vs. 51.7 ± 13.8 min, P =0.001). The advantage was believed to arise from the lack of need to switch laparoscopic instruments and the absence of surgical smoke in the surgical area due to the use of the Harmonic scalpel[18].

CONCLUSION

This study found that the use of harmonic scalpel technology in laparoscopic cholecystectomy provided several important benefits compared to traditional electrocautery. These advantages included shorter surgery duration, fewer instances of lens cleaning during the operation, reduced post-operative pain, and shorter hospital stays. Additionally, the harmonic scalpel was found to be a better option in terms of lower rates of intra-operative gall bladder perforation, blood loss, and the need for drainage. Ultrasonic harmonic is a secure and efficient technique for laparoscopic dissection in gallbladder stone illness. It offers an additional benefit over Monopolar electrocautery by providing a safer dissection process.

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