

## ORIGINAL ARTICLE

# To Compare the Dissection of Gallbladder by Ultrasonic Harmonic Scalpel Versus Electrocautery in Laparoscopic Cholecystectomy

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**ABSTRACT**

The gold standard treatment for symptomatic gallstone disease is laparoscopic cholecystectomy. Common gallbladder dissection methods include monopolar electrocautery and ultrasonic harmonic scalpel.

**Aim:** To compare harmonic scalpel and monopolar electrocautery for gallbladder dissection in laparoscopic cholecystectomy.

**Settings and Design:** A prospective observational study was conducted at a tertiary care teaching hospital.

**Materials and Methods:** This study comprised 120 laparoscopic cholecystectomy patients. Electrocautery (EC, n=60) and harmonic scalpel (HS, n=60) groups were evenly assigned. Demographics, operative length, intra-operative bleeding, complications, post-operative pain, nausea, and vomiting were documented and analysed.

**Statistical Analysis Used:** Independent Student's *t*-test, Chi-square and Mann-Whitney U test were used, with *p* < 0.05 considered significant.

**Results:** Both groups had similar demographics. The HS group had a considerably longer mean operational time ( $58.38 \pm 4.43$  minutes) compared to the EC group ( $45.31 \pm 2.84$  minutes, *p* < 0.001). The HS group had considerably decreased intra-operative bleeding (*p* < 0.001) and post-operative pain severity (*p* = 0.006). The EC

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group had greater intra-operative complications such gallbladder perforation and liver damage. No common bile duct injury was found in either group.

**Conclusion:** The harmonic scalpel is a safe and effective alternative to electrocautery in laparoscopic cholecystectomy, with less bleeding, complications, and post-operative pain but a lengthier procedure.

## KEYWORDS

• Laparoscopic cholecystectomy • Harmonic scalpel • Electrocautery

## KEY MESSAGES

1. In laparoscopic cholecystectomy, harmonic scalpel use significantly reduces intra-operative haemorrhage.
2. The harmonic scalpel group had less intra-operative problems and post-operative pain.
3. The harmonic scalpel safer and more successful gallbladder dissection.

## INTRODUCTION

Because of its reduced morbidity and faster recovery, laparoscopic cholecystectomy has become the standard treatment for symptomatic gallstone disease.<sup>1</sup> In laparoscopic cholecystectomy, monopolar electrocautery dissects the gallbladder utilising thermal energy.<sup>2</sup> The harmonic scalpel uses ultrasonic energy to cut and coagulate with minimal lateral thermal distribution and surgical smoke.<sup>3</sup> Comparison of these two energy sources is necessary to assess their efficacy and safety during laparoscopic cholecystectomy gallbladder dissection.<sup>4</sup>

## MATERIAL AND METHOD

### Study design and setting

A prospective comparative study was carried out in the Department of General Surgery at a tertiary care teaching hospital over a period of one year

### Study population and sample size

The study included all patients with gallstone symptoms, cholelithiasis or chronic calculus cholecystitis, and fulfilling the selection criteria. A minimum sample size of 60 patients per group was determined with a 95% confidence interval and 10% acceptable error. In the study, 120 patients were enrolled using a successive sample procedure and divided into two groups of 60 patients each.<sup>5</sup>

### Inclusion criteria

We included patients aged 18-60 with ultrasonographically confirmed cholelithiasis or chronic calculus cholecystitis who were fit for laparoscopic surgery under general anaesthesia.

### Exclusion criteria

People who had acute cholecystitis, gallbladder cancer, acute biliary pancreatitis, bleeding problems, were pregnant, had upper abdominal surgery before, or were not healthy enough for general anaesthesia were not allowed to participate.

## METHODOLOGY

The study was carried out in the Department of General Surgery at a tertiary care teaching hospital after getting approval from the Institutional Ethics Committee. After getting written informed permission, patients who met the inclusion criteria were added to the study. A total of 120 people with gallstone disease were included. They were divided into two groups of 60 each using a method called "consecutive sampling."

After a thorough clinical evaluation, all patients underwent routine pre-operative tests, such as a complete blood count, liver function tests, renal function tests, coagulation profile, blood sugar levels, an electrocardiogram, a chest X-ray, and an ultrasound of the abdomen to confirm the diagnosis.

Patients in Group A had a laparoscopic cholecystectomy with liver dissection using monopolar electrocautery. On the other hand, patients in Group B had an ultrasonic harmonic scalpel used for the same procedure. The duration of the surgery, intraoperative bleeding, gallbladder perforation, bile spillage, liver damage, and common bile duct injury were among the intraoperative data that were noted. Pain severity, nausea and vomiting, the requirement for a drain, the duration of drain placement, and the length of the hospital stay were all recorded and analysed after surgery.<sup>3</sup>

### Ethical considerations

Approval was obtained from the Institutional Ethics Committee, and written informed consent was taken from all patients before their inclusion in the study.

### Statistical Analysis

The independent Student's t-test was employed for continuous variables, whereas categorical

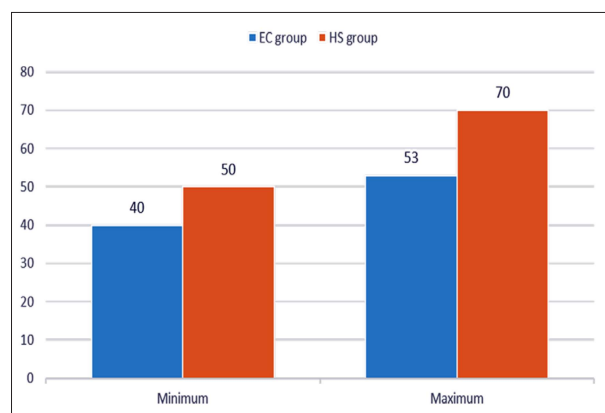
data were examined using the Chi-square test or Fisher's exact test whether applicable. Ordinal variables, including pain score, were evaluated with the Mann-Whitney U test. P-value <0.05 indicated statistical significance.

## RESULTS

A total of 120 patients who underwent laparoscopic cholecystectomy during the study period were included. Of these, 60 patients underwent surgery using monopolar electrocautery (EC group) and 60 patients using the harmonic scalpel (HS group), allowing equal comparison between the two techniques. Table 1 shows that the baseline demographic and clinical characteristics were comparable across the two groups. Females were the majority in both groups, with most patients aged between 31 and 40 years. Cholelithiasis was the predominant diagnosis in both the electrocautery and harmonic scalpel groups.

**Table 1:** Baseline characteristics of patients in Electrocautery and Harmonic scalpel groups

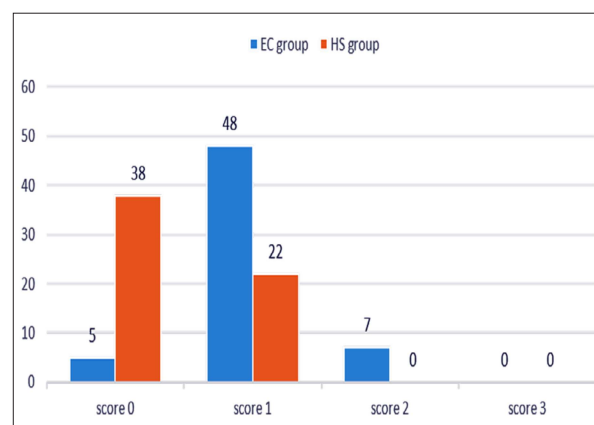
| Variable          | Category                       | EC group (n = 60) | HS group (n = 60) | Total (n = 120) |
|-------------------|--------------------------------|-------------------|-------------------|-----------------|
| Sex               | Male                           | 6 (10.0%)         | 18 (30.0%)        | 24 (20.0%)      |
|                   | Female                         | 54 (90.0%)        | 42 (70.0%)        | 96 (80.0%)      |
| Age group (years) | < 30                           | 17 (28.3%)        | 13 (21.7%)        | 30 (25.0%)      |
|                   | 31-40                          | 18 (30.0%)        | 17 (28.3%)        | 35 (29.2%)      |
|                   | 41-50                          | 12 (20.0%)        | 13 (21.7%)        | 25 (20.8%)      |
|                   | 51-60                          | 13 (21.7%)        | 17 (28.3%)        | 30 (25.0%)      |
|                   | > 60                           | 0 (0.0%)          | 0 (0.0%)          | 0 (0.0%)        |
| Diagnosis         | Cholelithiasis                 | 40 (66.66%)       | 41 (68.3%)        | 81 (67.5%)      |
|                   | Chronic calculus cholecystitis | 20 (33.33%)       | 19 (31.66%)       | 39 (32.5%)      |



**Figure 1:** Duration of surgery

Table 2 shows that the mean operating time was significantly longer in the harmonic scalpel group ( $58.38 \pm 4.43$  minutes) relative to

the electrocautery group ( $45.31 \pm 2.84$  minutes) ( $p < 0.001$ ).

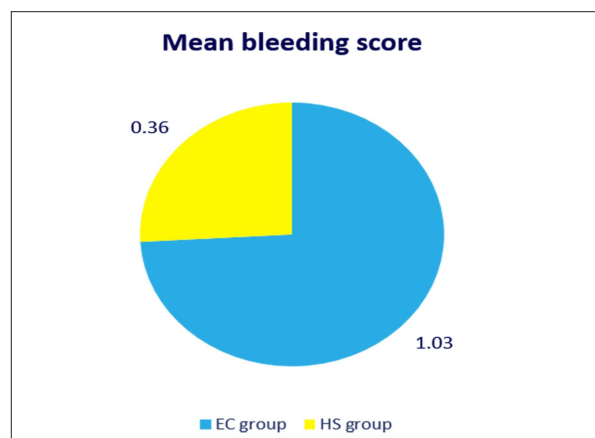


**Figure 2:** Intra-operative bleeding score

**Table 2:** Duration of surgery

| Parameter     | EC group (n = 60) | HS group (n = 60) | p-value |
|---------------|-------------------|-------------------|---------|
| Minimum       | 40                | 50                |         |
| Maximum       | 53                | 70                | < 0.001 |
| Mean duration | 45.31 ± 2.84      | 58.38 ± 4.43      |         |

Table 3 shows that intra-operative bleeding was significantly reduced in the harmonic scalpel group, exhibiting a lower mean bleeding score relative to the electrocautery group ( $p < 0.001$ ). The categorical distribution indicated a greater incidence of no or minimum bleeding in the harmonic scalpel group.

**Figure 3:** Mean intra-operative bleeding score**Table 3:** Intra-operative bleeding score distribution and comparison between study groups

| Bleeding parameter                     | EC group (n = 60) | HS group (n = 60) | p-value       |
|----------------------------------------|-------------------|-------------------|---------------|
| Bleeding score (categorical)           |                   |                   |               |
| 0 = Nil / Minimal (< 50 ml)            | 5 (8.33%)         | 38 (63.33%)       | 43            |
| 1 = Mild ( $\geq 50$ to < 100 ml)      | 48 (80.0%)        | 22 (36.66%)       | 70            |
| 2 = Moderate ( $\geq 100$ to < 200 ml) | 7 (11.66%)        | 0 (0%)            | 7             |
| 3 = Severe ( $\geq 200$ ml)            | 0 (0%)            | 0 (0%)            | 0             |
| Mean bleeding score $\pm$ SD           | 1.03 $\pm$ 0.44   | 0.36 $\pm$ 0.48   | $p < 0.001^*$ |

**Statistical test:** Mann-Whitney U test \*Statistically significant

Table 4 shows that intra-operative complications, such as gallbladder perforation, bile spillage, and liver injury, occurred more frequently in the electrocautery group, although no common bile duct injury was

noted in either group. Post-operative nausea and vomiting occurred less frequently in patients operated on with the harmonic scalpel.

**Table 4:** Intra-operative complications and post-operative nausea & vomiting

| Outcome                                     | Category                | EC group (n = 60) | HS group (n = 60) |
|---------------------------------------------|-------------------------|-------------------|-------------------|
| <i>Intra-operative complications</i>        | Gallbladder perforation | 10 (16.66%)       | 3 (5.0%)          |
|                                             | Bile spillage           | 9 (15.0%)         | 3 (5.0%)          |
|                                             | Liver injury            | 10 (16.66%)       | 0 (0%)            |
|                                             | CBD injury              | 0 (0%)            | 0 (0%)            |
| <i>Post-operative nausea &amp; vomiting</i> | Present                 | 18 (30.0%)        | 9 (15.0%)         |
|                                             | Absent                  | 42 (70.0%)        | 51 (85.0%)        |

Figure 4 depicts the distribution of post-operative pain intensity in the two study groups. A higher proportion of patients in the harmonic scalpel group reported mild pain,

while moderate pain was more commonly seen in the electrocautery group. No patient in either group experienced severe post-operative pain.

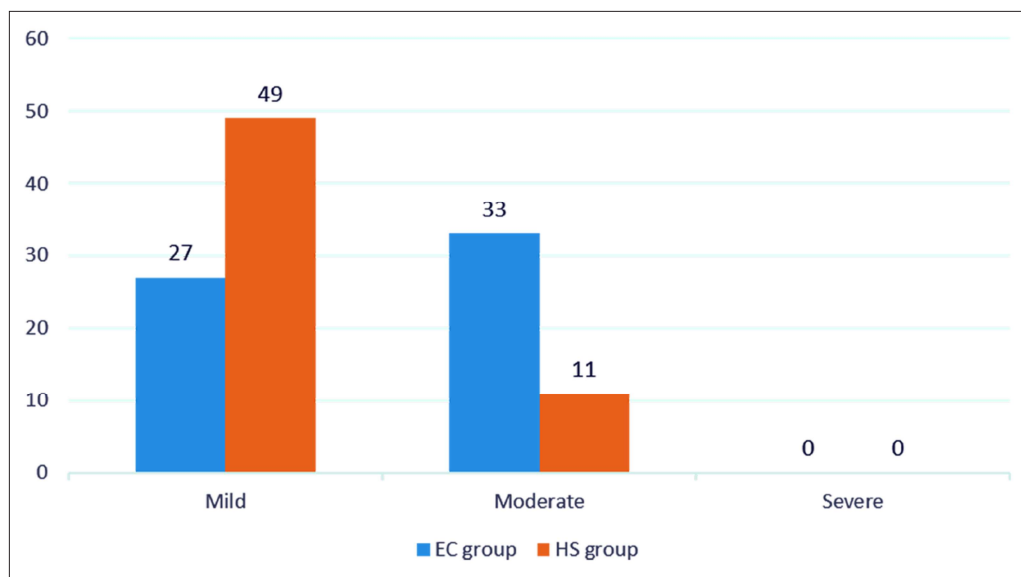


Figure 4: Post-operative pain score

## DISCUSSION

Gallstones are one of the most frequent surgical issues that are treated in the primary care practice. They are the most common right hypochondrium pain causes and a major cause of disability. Traditional gallstone disease treatment depends on stage and presentation. Acute gallbladder disease like acute cholecystitis can be treated conservatively, although surgery within 48–72 hours is now preferred. Laparoscopic cholecystectomy is the best surgery for symptomatic gallstones nowadays.

Patients in the study were mostly aged 31–40, with 30.0% in the electrocautery group and 28.3% in the harmonic scalpel group. The 41–50 age group made up 20.0% of the electrocautery group and 21.7% of the harmonic scalpel group. Both groups had similar age distributions and were statistically insignificant ( $p = 0.38$ ). Patients' mean age was  $39.21 \pm 11.4$  years for electrocautery and  $41.10 \pm 12.4$  years for harmonic scalpel, with no significant difference ( $p = 0.38$ ). Akami K et al. found that 36.0% of electrocautery patients were 31–40 years old and 34.0% aged 31–40. Harmonic group followed by 41–50 years with 26.0% Electrocautery and 24.0% Harmonic, statistically insignificant ( $p=0.834$ ). The Electrocautery group had a mean age of  $43.7 \pm 11.51$  years and the Harmonic group  $41.02 \pm 11.87$  years ( $p=0.255$ ).<sup>1</sup> Mahabaleshwar et al. found that electrocautery group mean age 47.36 years and harmonic group 45.3 years

( $p=0.55$ ).<sup>6</sup>

The study found a male-to-female ratio of 1:9 in the electrocautery group and 1:2.3 in the harmonic scalpel group, with similar demographics characteristics. Neha Gupta et al. found ES and HS had a 1:4 male-female ratio. Demographic indicators were similar for both groups.<sup>7</sup>

In this study, intra-operative complications were more prevalent in the electrocautery group than the harmonic scalpel group. Perforation of the gallbladder occurred in 10 cases (16.66%) of the electrocautery group and 3 cases (5%) of the harmonic scalpel group. Nine (15%) electrocautery patients and three (5%) harmonic scalpel cases experienced bile spillage. Liver injury occurred in 10 patients (16.66%) in the electrocautery group, while no cases were documented in the harmonic scalpel group. No common bile duct injury was found in either group. These findings align with Ramzanali et al., who found that harmonic scalpel use reduced gallbladder perforation and stone spillage compared to electrocautery.<sup>8</sup>

In this study, 8.33% of electrocautery patients experienced intra-operative bleeding ( $<50$  ml) compared to 63.33% of harmonic scalpel patients. Mild bleeding ( $\geq 50$  to  $<100$  ml) was more prevalent in the electrocautery group (80%) compared to the harmonic scalpel group (36.66%). In the electrocautery group, 11.66% experienced moderate bleeding ( $\geq 100$  to  $<200$  ml), while no patients in the harmonic

scalpel group experienced such bleeding. The bleeding score distribution showed reduced intra-operative bleeding with harmonic scalpel use. Similar findings were found by Mahjob et al., who found less intra-operative bleeding in harmonic scalpel patients compared to electrocautery.<sup>9</sup>

In this study, the harmonic scalpel group had a substantially longer mean operative time ( $58.38 \pm 4.43$  minutes) compared to the electrocautery group ( $45.31 \pm 2.84$  minutes) ( $p < 0.001$ ). **Manoj MS et al also reported** that HS group mean 52.84 minutes and the EC group 56.79 minutes.<sup>10</sup>

## CONCLUSION

The most effective treatment for gallstone disease symptoms is still laparoscopic cholecystectomy. Both groups in the current study had similar demographic characteristics. Despite requiring a longer operating time than electrocautery, the harmonic scalpel was associated to much less intra-operative bleeding, fewer intra-operative complications, and less post-operative pain. In laparoscopic cholecystectomy, the harmonic scalpel has generally shown itself to be a safe and efficient substitute for electrocautery, providing better operative and post-operative results.

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**Conflict of Interest:** None declared.

**Source of Support:** Nil.

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