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Comparative Study of Laparoscopic Cholecystectomy Techniques: Traditional Clipping versus Harmonic Scalpel Closure

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Abstract

***Background**: Laparoscopic cholecystectomy (LC), a widely used surgical procedure to remove the gallbladder, can vary in how the cystic duct and artery are closed. This study compared the safety and effectiveness of LC performed using the standard method (TM) with LC performed with harmonic scalpel assistance (HLC). **Methods**: A prospective comparison research with 30 patients in each group (LC and HLC) of 60 patients scheduled for LC was conducted. The length of the hospital stays, the number of antibiotics used, the number of surgical problems, postoperative bile leakage, and the length of the operation were all recorded. Suitable tests were used in the statistical analysis. **Results**: When compared to LC, HLC showed considerably shorter operating times (35.1 4.079 vs. 47.933 8.026 minutes, p0.0001) and less frequent need for antibiotics (3.267 0.691 vs. 4.367 0.809 days, p0.0001). Surgery-related complications were comparable between groups (LC 10% vs. HLC 6.67%, p=0.549). Postoperative bile leakage in HLC (0%) were trending lower than LC (6.67%, p=0.157). A shorter hospital stay was the result of HLC (3.1 + 0.547 vs. 4.4 + 0.855 days, p0.0001). **Conclusion**: In comparison to LC, HLC offers benefits such as faster recovery times, less need for antibiotics, and shorter hospital stays. Although there were no appreciable differences in postoperative problems in HLC, there was a tendency towards less intraoperative complications. These results back up the use of HLC as a secure and effective cholecystectomy option. It is need to do additional study with larger cohorts and longer follow-up.*

Keywords: *Laparoscopic cholecystectomy, Harmonic scalpel, Traditional method, Safety, Efficacy.*

1. Introduction

By providing patients with a less intrusive option to the standard open procedure for removing the gallbladder, laparoscopic cholecystectomy (LC) has transformed the field of surgery. Since its introduction in the late 1980s, LC has established itself as the gold standard for the care of symptomatic gallstone disease, cholecystitis, and other conditions involving the gallbladder [1]. Shorter hospital stays, quicker recuperation times, and better cosmetic results are just a few benefits of this minimally invasive procedure [2]. Despite being widely used, different surgical procedures, particularly the way cystic duct and artery closure is done, continue to be a source of discussion and research.

The insertion of clips to occlude the cystic duct and cystic artery during the traditional (TM) laparoscopic cholecystectomy procedure ensures that the gallbladder is isolated from the biliary network. Bile leakage and other surgical problems have been successfully avoided with this strategy [3]. It has several restrictions, though. Due to additional tissue manipulation during clip application, critics claim that using clips may result in a longer operating time and a higher chance of gallbladder perforation [4]. Additionally, some investigations have indicated that the conventional clip closure method may, while infrequently, result in problems such bile duct damage and strictures [5].

A different procedure known as Harmonic scalpel-assisted laparoscopic cholecystectomy (HLC) has grown in favor among surgeons in recent years. The Harmonic scalpel simultaneously cuts and coagulates tissue using ultrasonic radiation, providing accurate hemostasis without the use of clips [6]. HLC proponents contend that it shortens the surgical procedure, lessens tissue damage, and lowers the risk of gallbladder perforation, all of which could enhance patient outcomes [7-10].

The need for well-designed comparative studies that unbiasedly assess the safety and effectiveness of this procedure in comparison to the conventional clip closure method still exists despite the increased interest in HLC. By offering a thorough review of intraoperative and postoperative parameters in patients undergoing LC utilizing both procedures, this study seeks to close this information gap.

This study's main goal is to assess the safety and effectiveness of HLC and LC in relation to important surgical characteristics such operative time, use of antibiotics, postoperative problems, and length of hospital stay. We will also look into each technique's possible benefits and drawbacks, giving light on how each technique can benefit patient care.

2. Materials And Methods

Patient selection and study design:

Over the course of 18 months, this prospective comparison study was carried out at a tertiary care facility. Patients who were scheduled for laparoscopic cholecystectomy and had symptoms of gallstone disease, cholecystitis, or other disorders linked to the gallbladder were included in the study. All participants gave their informed consent.

Group Assignment & Surgical Procedures

A computerized random number generator was used to create a randomization strategy that divided the patients into two groups. 30 patients who had laparoscopic cholecystectomy with conventional clip closure of the cystic duct and cystic artery made up Group LC (Traditional Method). Thirty patients who underwent laparoscopic cholecystectomy with Harmonic scalpel-assisted closure made up Group HLC (Harmonic Scalpel).

Group LC (Traditional Method): In the conventional approach, the cystic duct and cystic artery were isolated and clipped with titanium clips. After that, the gallbladder was cut open and taken out. Group HLC (Harmonic Scalpel): In this group, the cystic duct and cystic artery were dissected without the use of clips using the Harmonic scalpel (Ethicon, Cincinnati, OH, USA). Ultrasonic energy from the scalpel was used for precision cutting and coagulation.

Data Gathering & Analytical Statistics

Each patient's intraoperative and postoperative data were gathered, including:
Operating time in minutes
Use of antibiotics (days)
risks associated with surgery
issues following surgery (such as bleeding and bile leaks)
(Days) total length of hospital stay

Statistical analysis tools (such SPSS and SAS) were used to examine the data. Categorical data were expressed as percentages, whereas continuous variables were expressed as means standard deviations (SD). For categorical variables, the chi-square test or Fisher's exact test was used, and for continuous variables, the t-test. Statistical significance was defined as a p-value 0.05.

Ethics-Related Matters:

This study was authorized by the [Institutional Review Board/Ethics Committee] at [Name of Hospital] and carried out in accordance with the guidelines specified in the Declaration of Helsinki. Before participating, all patients gave their informed consent.

Calculating the sample size

Based on the major outcome measure of operative duration and with a power of 80% and a significance threshold of 0.05, sample size calculations were made. It was concluded that a sample size of 30 patients per group was adequate to identify a clinically significant difference.

Blinding and randomization:

To reduce selection bias, patients were randomly assigned using random numbers produced by a computer. Due to the nature of the intervention, surgeons were not blinded to the technique utilized, however data analysts were during the statistical analysis to reduce potential bias.

Measures of Results:

Operative time and antibiotic use were the main outcome indicators. The frequency of intraoperative and postoperative problems, such as bile leak, hemorrhage, and length of hospital stay, were secondary outcome measures.

3. Results and Discussion

The study participants' initial characteristics for both groups are shown in Table 1. Age, gender distribution, BMI, and preoperative diagnoses between the LC (Traditional Method) and HLC (Harmonic Scalpel) groups did not differ statistically significantly. The intraoperative and postoperative parameters for both groups are listed in Table 2. It should be noted that the Harmonic scalpel-assisted laparoscopic cholecystectomy (HLC) group had a considerably shorter operating time (35.1 ±4.079 minutes) than the traditional procedure (LC) group (47.933± 8.026 minutes) ($p<0.0001$). Additionally, compared to LC (4.367± 0.809 days), HLC (3.267± 0.691 days) had lower antibiotic usage ($p< 0.0001$) than LC (4.367± 0.809 days).

10% in LC and 6.67% in HLC experienced surgical problems, which was the same occurrence in both groups ($p=0.549$). Although this difference was not statistically significant ($p=0.157$), there was a trend towards a reduced rate of postoperative biliary leak in the HLC group (0%) compared to LC (6.67%). Additionally, compared to LC (4.4 ± 0.855 days), HLC required a considerably shorter hospital stay (3.1± 0.547 days) ($p< 0.0001$).

The postoperative problems in both groups are broken down in Table 3. 2 patients (6.67%) in the LC group reported bile leaks, compared to 1 patient's 3.33% bleeding and another patient's 3.33% infection. The HLC group, in comparison, demonstrated no instances of postoperative bile leak, one instance of bleeding (3.33%), and two instances of infection (6.67%).

Table 1: Baseline Characteristics of Study Participants

Characteristic	Group LC (Traditional Method)	Group HLC (Harmonic Scalpel)
Total Number of Patients	30	30
Age (years, Mean ± SD)	45.2 ± 6.3	43.8 ± 7.1
Gender (Male/Female)	12/18	13/17
BMI (Mean ± SD)	28.5 ± 3.2	27.9 ± 3.0
Preoperative Diagnosis		
- Cholelithiasis	21	20
- Acute Cholecystitis	9	10

Table 2: Intraoperative and Postoperative Parameters

Parameter	Group LC (Traditional Method)	Group HLC (Harmonic Scalpel)	p-value
Operative Duration (minutes, Mean ± SD)	47.933 ± 8.026	35.1 ± 4.079	<0.0001
Antibiotic Usage (days, Mean ± SD)	4.367 ± 0.809	3.267 ± 0.691	<0.0001
Complications During Surgery (%)	10%	6.67%	0.549
Postoperative Bile Leak (%)	6.67%	0%	0.157
Duration of Hospital Stay (days, Mean ± SD)	4.4 ± 0.855	3.1 ± 0.547	<0.0001

Table 3: Postoperative Complications

Complication	Group LC (Traditional Method)	Group HLC (Harmonic Scalpel)
Bile Leak	2 (6.67%)	0 (0%)
Bleeding	1 (3.33%)	1 (3.33%)
Infection	1 (3.33%)	2 (6.67%)

The results of this study offer insightful comparisons between the outcomes of laparoscopic cholecystectomy (LC) carried out using the conventional technique (TM) and LC carried out with harmonic scalpel aid (HLC). The main conclusions, their ramifications, and the background of previous work will be the main topics of the debate.

Operational Time: The large reduction in operating duration associated with HLC compared to LC (TM) is one of the study's most important findings. The mean operating time was much less in the HLC group (35.1± 4.079 minutes) than in the LC group (47.933± 8.026 minutes) ($p< 0.0001$). This decrease in surgical time is consistent with the Harmonic scalpel's claimed advantages in establishing effective hemostasis and tissue dissection [8].

For a number of reasons, shorter operating times have clinical value. First, they aid in lowering intraoperative stress for the patient as well as the surgical team, potentially improving the surgical experience as a whole. Second, fewer intraoperative issues and shorter anesthetic exposure times can result in shorter procedures, which can increase patient safety [9]. Third, by enabling more treatments to be completed in a given amount of time, reduced operating times can improve the effectiveness of operating room use and potentially save healthcare costs.

Usage of Antibiotics: The HLC group used antibiotics much less than the LC group (3.267 ± 0.691 days vs. 4.367± 0.809 days; $p< 0.0001$), which is another noteworthy finding. This data raises the possibility that HLC lowers the incidence of postoperative infection, perhaps as a result of less tissue manipulation and bile spilling.

The decrease in antibiotic use is consistent with antimicrobial stewardship's overarching objective, which is to optimize antibiotic use to prevent the emergence of antibiotic resistance and lower healthcare-associated illnesses [10]. The potential cost savings and benefits of reducing antibiotic resistance are supported by the use of fewer antibiotics in HLC without affecting patient safety.

Surgery Complications: Although there was no statistically significant difference in the incidence of surgery complications between the two groups (LC 10% vs. HLC 6.67%, $p=0.549$), the HLC group's reduced incidence is remarkable. A reasonably low prevalence of postoperative complications was seen in both groups, demonstrating the safety of the laparoscopic cholecystectomy as a minimally invasive technique.

Postoperative Bile Leak: Although there was no statistically significant difference between the LC group (6.67%) and the HLC group (0%), there was a trend towards a reduced rate of postoperative bile leaks in the HLC group. One of the known side effects of cholecystectomy is bile leakage, which can result in extended hospital stays, extra surgeries, and higher healthcare expenses [11]. The pattern found in this study points to the possibility that using the Harmonic scalpel during HLC may improve bile duct closure and lessen bile leakage.

Hospital Stay Length: Regarding surgical recovery, HLC was linked to a considerably shorter hospital stay than LC (3.1 ± 0.547 days vs. 4.4 ± 0.855 days; $p<0.0001$). This outcome is in line with other research that showed laparoscopic surgery patients had shorter hospital stays [12]. Reduced hospital stays help patients by enabling a quicker return to daily activities, but they may also result in financial savings for healthcare organizations.

The results of this study are consistent with and add to the body of knowledge already available on laparoscopic cholecystectomy procedures [11-15]. The benefits of the Harmonic scalpel in cholecystectomy have previously been the subject of several research. The findings of researchers by Harris et al. [14] that revealed a lower incidence of postoperative infections in patients having

cholecystectomy with the Harmonic scalpel are also supported by the reduced antibiotic consumption shown in the HLC group.

Limitations: There are certain limitations to this study that should be taken into account. First off, the study was limited in its ability to be generalized because it was only undertaken at one institution. Larger sample sizes and multicentre trials may be able to shed more light on the safety and effectiveness of HLC. Second, the study's relatively brief follow-up time made it difficult to evaluate long-term results. Future studies might concentrate on long-term monitoring to assess how long-lasting these results are.

4. Conclusion

This comparative study shows that Harmonic scalpel-assisted laparoscopic cholecystectomy (HLC) has a number of benefits over the conventional procedure (LC) in terms of the length of the operation, the need for antibiotics, and the length of the hospital stay. Although there was no statistically significant difference in postoperative bile leakage or surgical complications, HLC showed a trend towards increased safety. These results support the use of HLC as a safe and effective alternative to gallbladder removal, potentially improving patient outcomes and lowering healthcare costs. When choosing cholecystectomy approaches, surgeons should take the advantages of the Harmonic scalpel into account. It is necessary to do additional study with larger sample sizes and longer follow-up times in order to confirm these findings and determine their long-term ramifications.

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