



A COMPARATIVE STUDY OF MONOPOLAR HOOK VERSUS HARMONIC SCALPEL IN LAPAROSCOPIC CHOLECYSTECTOMY

General Surgery

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ABSTRACT

Introduction: Laparoscopic cholecystectomy is a widely performed procedure for gallbladder disease, with advancements in surgical instruments enhancing patient outcomes. This study aimed to compare the effectiveness of the Monopolar Hook and Harmonic Scalpel in terms of intraoperative parameters, surgical outcomes, and complications. **Materials And Methods:** A prospective, comparative study was conducted on 106 patients undergoing laparoscopic cholecystectomy, divided into Group 1 (Monopolar Hook, n = 53) and Group 2 (Harmonic Scalpel, n = 53). Patient demographics, intraoperative variables (blood loss, operative time, complications), and postoperative outcomes were analyzed. Statistical significance was set at $P < 0.05$. **Results:** The Harmonic Scalpel group had significantly lower intraoperative blood loss (39.64 ± 33.87 ml vs. 49.74 ± 12.55 ml, $P = 0.04$). Gallbladder perforation (5.67% vs. 13.20%, $P = 0.03$) and bile spillage (0% vs. 7.54%, $P = 0.05$) were significantly lower in the Harmonic Scalpel group. **Conclusion:** The Harmonic Scalpel demonstrated superior hemostatic control, lower gallbladder perforation, and reduced bile spillage, though operative time differences were not significant. It may be a preferable alternative for laparoscopic cholecystectomy due to its improved intraoperative safety and outcomes.

KEYWORDS

Harmonic Scalpel, laparoscopic cholecystectomy, Monopolar Hook and gallbladder

INTRODUCTION

Laparoscopic cholecystectomy (LC) is widely acknowledged as the "gold standard" for the surgical management of symptomatic gallstone disease and acute cholecystitis. This minimally invasive technique is favoured for its numerous advantages over open surgery, including reduced postoperative pain, shorter hospital stays, quicker recovery times, and enhanced patient outcomes. The widespread adoption of LC is largely due to its ability to provide effective treatment while minimizing the physical trauma associated with traditional open surgical procedures^[1,2]. In standard LC procedures, the surgical team uses specialized instruments designed for precise tissue dissection and hemostasis. One of the most commonly used tools is the monopolar electrosurgical hook, which operates using high-frequency electrical energy to cut and coagulate tissue efficiently^[3]. Despite the efficacy of the monopolar electrosurgical hook in laparoscopic cholecystectomy, it is not without certain limitations. One of the primary concerns is the potential for thermal injury to surrounding tissues, which can lead to significant complications such as gallbladder perforation and bile leakage due to clip displacement^[4]. The harmonic scalpel uses ultrasonic energy to simultaneously achieve three effects: cutting, coagulating, and performing cavitation. This technology operates at temperatures below 80°C, significantly reducing lateral thermal spread, which in turn minimizes the potential for thermal damage to adjacent tissues. The introduction of the harmonic scalpel is particularly beneficial in overcoming the limitations associated with monopolar electrosurgical instruments. It offers a safer and more effective solution by reducing thermal injury and minimizing complications, making it a valuable tool in modern laparoscopic cholecystectomy procedures^[5]. In comparison to the traditional monopolar electrosurgical hook, the harmonic scalpel offers several advantages. Notably, it results in shorter operative times, reduced intraoperative bleeding, and a lower incidence of postoperative complications, such as gallbladder perforation^[6]. This study aims to compare the outcomes of laparoscopic cholecystectomy performed using the harmonic scalpel with those of conventional LC using monopolar electrocautery.

MATERIALS AND METHODS

This study was a randomized, comparative study conducted after obtaining approval from the Institutional Ethics Committee, KD Medical College, Mathura. Written informed consent was obtained from all patients. The study included 106 patients with a clinical and radiological diagnosis of cholelithiasis.

- 53 patients underwent laparoscopic cholecystectomy using a monopolar instrument.
- 53 patients underwent laparoscopic cholecystectomy using a harmonic scalpel.

Inclusion Criteria

- Patients of all age groups who were admitted for gallstone disease and underwent laparoscopic cholecystectomy.

- Patients diagnosed with acute cholecystitis.
- Patients who provided written informed consent.

Exclusion Criteria

- Patients with choledocholithiasis.
- Patients diagnosed with cholangitis.
- Patients with suspected gallbladder carcinoma.
- Patients with gallstone-induced pancreatitis.
- Pregnant patients.

Methodology

Patient Selection and Grouping

All study participants who met the inclusion criteria and underwent laparoscopic cholecystectomy were included. Based on intraoperative findings, patients were classified using the **Surgue et al. scoring system**:

- **Group A:** Patients with a score < 5
- **Group B:** Patients with a score > 5 , considered difficult cholecystectomy cases

Both **Group A** and **Group B** were further divided into **two subgroups**, equally distributed using computer-generated randomization:

- **Group 1:** Laparoscopic cholecystectomy using a **monopolar hook**
- **Group 2:** Laparoscopic cholecystectomy using a **Harmonic Scalpel**

Statistical Analysis

The comparison of the variables which were quantitative in nature were analysed using Independent t test. The comparison of the variables which were qualitative in nature was analysed using Chi-Square test. Data analysis was done with the use of Statistical Package for Social Sciences (SPSS) software, IBM manufacturer, Chicago, USA, ver 25.0.

RESULTS

The study aimed to compare the intraoperative and postoperative outcomes of laparoscopic surgeries performed using the Monopolar Hook and Harmonic Scalpel techniques. A total of 106 patients were enrolled and randomized into two equal groups: Group 1 (Monopolar Hook, n = 53) and Group 2 (Harmonic Scalpel, n = 53).

Intraoperative bleeding data demonstrated a significant difference between the two groups. Group 1 (Monopolar Hook) recorded a mean blood loss of 49.74 ± 12.55 ml, while Group 2 (Harmonic Scalpel) exhibited a lower mean blood loss of 39.64 ± 33.87 ml. The P-value of 0.04 indicates that this reduction in intraoperative bleeding with the Harmonic Scalpel is statistically significant. (Figure 1)

In this present study, Gallbladder and duct perforation was higher i.e. 7(13.2%) in monopolar hook in comparison to Harmonic Scalpel i.e.

3 (5.67%) & result found to be significant using chi square test. (Figure 2)

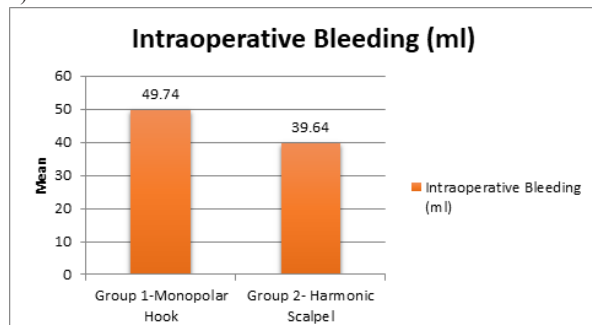


Figure 1. Intraoperative Bleeding (ml) Data Between Monopolar Hook and Harmonic Scalpel

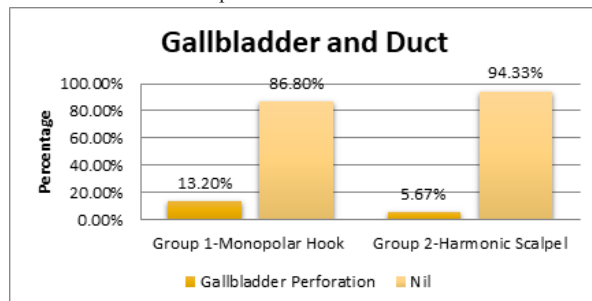


Figure 2. Gallbladder And Duct Perforation In Groups

In this present study, bile spillage in monopolar hook occurred in 7.54% of patients, while there were no cases of isolated bile spillage in the Harmonic Scalpel group. Both groups had an equal incidence (5.67%) of combined stone and bile spillage. The P-value of 0.05 indicates that the lower incidence of bile spillage in the Harmonic Scalpel group approached statistical significance, suggesting that this technique may reduce the risk of intraoperative spillage compared to the Monopolar Hook. (Figure 3)

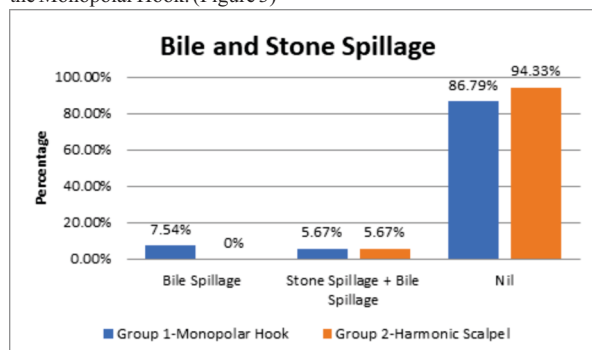


Figure 3. Bile And Stone Spillage In Groups

DISCUSSION

Intraoperative bleeding was significantly lower in the Harmonic Scalpel group (39.64 ± 33.87 ml) compared to the Monopolar Hook group (49.74 ± 12.55 ml) ($P = 0.04$). Samer S. Bessa et al. (2011)^[39] similarly reported reduced bleeding with the Harmonic Scalpel (mean blood loss of 35 ml) versus the Monopolar Hook (mean blood loss of 50 ml). Arash Taheri et al. (2014)^[41] found a significant reduction in intraoperative bleeding was observed in the Harmonic Scalpel group, with an average blood loss of 39.64 ± 33.87 ml compared to 49.74 ± 12.55 ml in the Monopolar Hook group ($P = 0.04$). Gallbladder perforation was significantly lower in the Harmonic Scalpel group (5.67%) compared to the Monopolar Hook group (13.20%) ($P = 0.03$). Soltan et.al. (2015)^[42] reported a 6% perforation rate with the Harmonic Scalpel, aligning with our findings, while the Monopolar Hook group showed a higher rate (12%). Bile spillage occurred in 7.54% of cases in the Monopolar Hook group, while none were recorded in the Harmonic Scalpel group ($P = 0.05$). This mirrors findings by Samer S. Bessa et al. (2011),^[39] who reported 0% bile spillage with the Harmonic Scalpel and 8% with the Monopolar Hook. Combined bile and stone spillage was equal in both groups (5.67%),

comparable to results by Arash Taheri et al. (2014),^[41] who found a 5% rate in both groups. Gallbladder perforation was significantly lower in the Harmonic Scalpel group (5.67%) compared to the Monopolar Hook group (13.20%) ($P = 0.03$). Roberta Gelmini et al. (2010)^[38] reported a perforation rate of 6% with the Harmonic Scalpel, closely matching our results. Bile spillage occurred in 7.54% of cases in the Monopolar Hook group, while no instances were recorded in the Harmonic Scalpel group ($P = 0.05$). Combined bile and stone spillage was observed equally in both groups (5.67%). Tharwat Kandil et al. (2010)^[37] observed bile spillage rates of 8% in conventional techniques, supporting the superior precision of the Harmonic Scalpel in our study. Gallbladder perforation was significantly lower in the Harmonic Scalpel group (5.67%) than in the Monopolar Hook group (13.20%) ($P = 0.03$). This is consistent with Amer Yehia et al. (2019),^[49] who reported a 6% perforation rate with the Harmonic Scalpel, attributing the reduction to its precision and minimal thermal spread. Bile spillage was observed in 7.54% of cases in the Monopolar Hook group, with no instances in the Harmonic Scalpel group ($P = 0.05$). Combined bile and stone spillage was equal in both groups (5.67%). Similar trends were reported by Kilambi Srinivasi et al. (2021),^[51] who found a bile spillage rate of 2% in Harmonic Scalpel cases, highlighting its role in maintaining gallbladder integrity.

CONCLUSION

This study compared the intraoperative and postoperative outcomes of laparoscopic surgeries performed using the Monopolar Hook and Harmonic Scalpel techniques. The Harmonic Scalpel group exhibited significantly lower intraoperative blood loss ($p = 0.04$) and reduced gallbladder perforation rates ($p = 0.03$) compared to the Monopolar Hook group. Furthermore, bile spillage was exclusively reported in the Monopolar Hook group, though the difference in overall spillage rates approached statistical significance ($p = 0.05$). These findings suggest that the Harmonic Scalpel may offer advantages in reducing intraoperative bleeding and gallbladder perforation rates, leading to a safer surgical approach with potentially fewer postoperative complications. Further large-scale studies are warranted to validate these findings and establish optimal surgical techniques for improved patient outcomes in laparoscopic procedures.

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