Original Article

Comparison of Conventional Laparoscopic Cholecystectomy with Clips and Laparoscopic Cholecystectomy Using Ligasure (High Energy Vessel Sealing Devices) Without Clips in Terms of Hemostasis

Conventional Laparoscopic Cholecystectomy with Clips and Laparoscopic Cholecystectomy

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ABSTRACT

Objective: To determine and compare mean intraoperative blood loss and mean time for achieving hemostasis in patients undergoing laparoscopic cholecystectomy using clips versus LigaSure vessel sealing system.

Study Design: Randomized clinical trial study

Place and Duration of Study: This study was conducted at the Department of Surgery, Pakistan Ordnance Factories Hospital, Wah Cantt, over a period of six months from November 2025 till January 2026.

Methods: A total of 114 patients between 18–60 years of age undergoing elective laparoscopic cholecystectomy were included in this study using non-probability consecutive sampling and randomized into two equal groups. Group A underwent cystic artery ligation with titanium clips, while Group B underwent vessel sealing using LigaSure. Intraoperative blood loss and time for achieving hemostasis were recorded and analyzed using the independent samples t-test.

Results: Patients in the LigaSure group demonstrated significantly lower mean intraoperative blood loss and shorter mean time to achieve hemostasis compared to the clip group ($p \leq 0.05$).

Conclusion: LigaSure is a safe and effective alternative to titanium clips for cystic artery control in laparoscopic cholecystectomy and may provide superior hemostatic outcomes.

Key Words: Laparoscopic cholecystectomy, LigaSure, titanium clips, hemostasis, blood loss

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INTRODUCTION

Laparoscopic cholecystectomy has been established as the gold standard surgical technique for symptomatic cholelithiasis since its introduction by Mühe in 1985. Over the decades of refinements in operative technique and instrumentation have resulted in better safety and efficiency, and also decreased complications. A critical step in laparoscopic cholecystectomy is to secure control of the cystic artery and cystic duct because the inadequate hemostasis may result in intraoperative hemorrhage, poor surgical field visualization, bile duct injuries and the need to convert to open surgery[1].

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Conventionally the titanium clips are used for sealing cystic artery because they are readily available, cost-effective, and easy to apply. Despite their widespread use, their complications such as clip slippage, its migration, bile duct injury, and the late complications such as formation of choledocholithiasis have been reported by many[2,3]. Also, in the presence of acute inflammation, dense adhesions, or a frozen Calot's triangle, the safe clip application to the target may be technically challenging.[4]

Over the years, the evolution of energy devices in surgery has significantly improved the minimally invasive surgery. For example, advanced bipolar vessel sealing systems such as LigaSure seal the vessels by denaturing the collagen and elastin within the vessel wall, providing a reliable hemostasis for vessels having diameter up to 7 mm[5,6]. The use of LigaSure has been successfully implied in thyroidectomy, hysterectomy, colorectal surgery, thoracic surgery, and soft tissue procedures, with evidence showing decreased blood loss and better surgical outcomes[7,8].

Specifically considering laparoscopic cholecystectomy, the use of ultrasonic and advanced energy devices has resulted in decreased operative time, improved surgical field visibility, and decreased blood loss as compared to

conventional techniques such as titanium clips application[9,10]. However, limited local and international studies exist on this important topic which directly compare LigaSure use with conventional titanium clips, particularly with regards to objective parameters such as intraoperative hemorrhage and time for achieving hemostasis. This study was designed to fill this gap and provide the evidence relevant to surgical practice in resource-limited settings.

METHODS

This randomized clinical trial was conducted in the Department of Surgery, Pakistan Ordnance Factories Hospital Wah Cantt, over three months duration. Ethical approval for this study was obtained from the Institutional Ethical Review Board of Pakistan Ordnance Factories Hospital Wah Cantt, before starting the study. Written informed consent was obtained from all the participants after explaining the nature, purpose, benefits, and potential risks of the study. Confidentiality of patient data was maintained throughout the process, and participants reserved the right to withdraw at any stage of study without consequence to their treatment.

A total of 114 patients between 18 to 60 years of age undergoing elective laparoscopic cholecystectomy for any indication were enrolled using non-probability consecutive sampling. Written informed consent was obtained from all patients. Those requiring conversion to open cholecystectomy, those with known inherited or acquired bleeding diathesis, and those undergoing another concomitant major surgical procedure were excluded to minimize the confounding factors.

Following enrollment, the patients were randomly allocated to two groups using the lottery method. Group A underwent cystic artery ligation using conventional titanium clips. Group B underwent cystic artery control using the LigaSure vessel sealing system without clip application.

All procedures were performed using a standardized four-port technique by the same consultant surgeon to eliminate inter-operator variability. The same type and size of titanium clips and the same LigaSure device settings were used throughout the study to maintain consistency. Calot's triangle dissection was performed according to the critical view of safety principle in all cases.

Intraoperative blood loss was calculated by measuring the difference between pre- and post-procedure weight of suction bottles, gauze pieces, and abdominal sponges using a standardized weighing scale. Time for achieving hemostasis was calculated from the onset of bleeding from the cystic artery, if any, until complete cessation. These measurements were recorded intraoperatively by a trained observer blinded to group allocation to minimize observer bias.

All patients received standard perioperative care according to institutional protocol. Intraoperative complications were documented. Patients requiring conversion to open surgery were excluded from final analysis as per predefined criteria.

Data were entered and analyzed using SPSS version 26. Quantitative variables were expressed as mean ± standard deviation. The independent samples t-test was applied to compare intraoperative blood loss and time to achieve hemostasis between the two groups. A p-value ≤ 0.05 was considered statistically significant.

RESULTS

A total of 114 patients were included, with 57 in each group. The two groups were comparable with respect to baseline demographic characteristics, including age, gender distribution, and body mass index, minimizing confounding effects on outcomes (Table I).

Table No. I: Baseline Characteristics of Patients

Variable	Group A (Clips, n=57)	Group B(LigaSure, n=57)
Age (years)	43.2 ± 9.1	42.6 ± 8.8
Gender (M/F)	21 / 36	23 / 34
BMI (kg/m^2)	27.4 ± 3.2	27.1 ± 3.0

(Values are presented as mean ± standard deviation or as numbers.)

Intraoperative outcomes are presented in Table II. Patients in the LigaSure group demonstrated significantly lower mean intraoperative blood loss and shorter mean time to achieve hemostasis compared to the clip group. Mean operative time was comparable between the two groups.

Table No.2: Comparison of Intraoperative Outcomes

Outcome	Group A (Clips, n=57)	Group B (LigaSure, n=57)	p-value
Intraoperative blood loss (ml)	42.3 ± 10.5	18.7 ± 6.2	<0.001
Time to achieve haemostasias (sec)	85.4 ± 18.2	32.6 ± 8.9	<0.001
Operative time (min)	48.6 ± 11.3	46.2 ± 10.8	0.24

(Values are presented as mean ± standard deviation. p-values calculated using independent samples t-test.)

DISCUSSION

This randomized clinical trial shows that the use of LigaSure for cystic artery sealing during laparoscopic cholecystectomy is associated with improved

hemostasis compared to the conventional titanium clips. The observed reduction in intraoperative blood loss and shorter time required to achieve the hemostasis in the LigaSure group shows that advanced bipolar vessel sealing devices provide more reliable vascular control.

Effective hemostasis is particularly important in laparoscopic cholecystectomy, where even small volume of hemorrhage can significantly decrease the filed visualization and increase operative difficulty. LigaSure achieves vessel sealing through controlled bipolar energy delivery, resulting in permanent fusion of collagen and elastin fibers within the vessel wall. This mechanism likely accounts for the better hemostasis observed in the present study.

Our findings are consistent with previous reports. For example, the several studies demonstrated significantly reduced intraoperative blood loss and operative time in laparoscopic cholecystectomy performed using high-energy devices compared to conventional techniques[11]. Studies have reported improved visualization and reduced blood loss with ultrasonic dissection in laparoscopic cholecystectomy[12]. Although many studies have focused on ultrasonic devices, available evidence suggests that LigaSure also provides the comparable efficacy and safety[13].

Concerns regarding thermal injury to adjacent structures, particularly the bile duct, have been raised with energy-based devices. However, several studies have shown that when used correctly, LigaSure does not increase the risk of bile duct injury or postoperative bile leak when compared to the conventional methods[14]. No bile duct injuries or major complications were observed in the present study.

An important strength of this study is the assessment of time for achieving hemostasis, an outcome that is not frequently reported in the existing studies. Shorter time required to achieve hemostasis may translate into improved efficiency, reduced surgeon's fatigue, and potentially lower conversion to open cholecystectomy rates in difficult cases[15].

The findings of this study are especially relevant in our local context, where titanium clips remain the standard of care. While the initial cost of LigaSure may seem higher, its potential benefits in terms of efficiency and reduced hemorrhage may justify its use particularly in selected cases, such as acute cholecystitis or in case of difficult dissection[16].

This study has some limitations however, as it was conducted at a single center with a relatively short follow-up period. Also, the long-term outcomes, cost-effectiveness, and postoperative pain were not evaluated. So multicenter studies with larger sample sizes and longer follow-up periods are recommended to validate these findings further and assess its generalizability.

CONCLUSION

LigaSure is a safe and effective alternative to titanium clips for cystic artery control during laparoscopic cholecystectomy. Its use is associated with decreased intraoperative hemorrhage and comparatively shorter time required to achieve hemostasis than titanium clips, especially in technically challenging cases.

Author's Contribution:

Concept & Design or acquisition of analysis or interpretation of data:	Muhammad Usama Tariq, Muhammad Azhar
Drafting or Revising Critically:	Sana Bashir, Asad Janjua
Final Approval of version:	All the above authors
Agreement to accountable for all aspects of work:	All the above authors

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