Original Article

Comparison Of Perioperative Outcomes Of Ligasure Vessel Sealing System Versus Conventional Suturing In Total Abdominal Hysterectomy

Sadaf Zohra[1], Fareeha Zaheer[2], Uzma Urooj[3], Adil Ali[4], Uzma Gull[5], Noureen Jawad[6]

Abstract

Objective: To assess intra- and postoperative complications associated with LigaSure use in total abdominal hysterectomy (TAH) and to compare perioperative hemoglobin and hematocrit changes with conventional suture ligation.

Methods: A Prospective, cross-sectional, comparative study was conducted in the department of Obstetrics and Gynecology, PEMH Rawalpindi, from August 2022 to August 2023. A total of 212 women undergoing TAH were enrolled through convenience sampling and allocated into two equal groups. Group A underwent TAH using LigaSure, while Group B underwent surgery with conventional suturing. Sample size was calculated using G*Power with 95% power, α=0.05, and an effect size of 0.49 based on postoperative hemoglobin differences reported in previous studies. Outcomes included operative time, perioperative hemoglobin/hematocrit changes, transfusion requirements, analgesic use, and intra- and postoperative complications.

Results: LigaSure significantly reduced intraoperative blood loss, operative time, and postoperative pain scores compared to conventional suturing. Group A demonstrated a smaller decline in hemoglobin and hematocrit levels and a lower frequency of blood transfusion. Additionally, postoperative analgesic requirements, complication rates, and hospital stay were reduced in the LigaSure group.

Conclusion: The LigaSure vessel sealing system offers superior perioperative outcomes compared to conventional suture ligation in TAH, contributing to reduced blood loss, operative complications, and shorter hospitalization.

Keywords: Hysterectomy; Hemostasis, Surgical; Electrocoagulation; Blood Loss, Surgical; Postoperative Complications; Operative Time; Analgesics; Hemoglobins; Hematocrit; Bipolar Coagulation.

Introduction

Hysterectomy remains one of the most frequently performed gynecological surgical procedures worldwide.[1] Epidemiological data from India report that approximately 3.3% of women aged 15–49 years have undergone a hysterectomy.[2] The majority of these procedures are performed for benign conditions, including abnormal uterine bleeding, uterine fibroids, uterovaginal prolapse, and chronic pelvic pain.[2] Although hysterectomy is considered a definitive treatment for many gynecologic disorders, it is not without perioperative risks.

The overall success of any surgical procedure is largely determined by the rate of intraoperative and postoperative complications.[3] In abdominal hysterectomy, one of the major intraoperative challenges is effective hemostasis, as excessive blood loss may increase transfusion requirements and prolong hospitalization. Surgical site infection remains one of the most common postoperative complications, with reported rates ranging from 1% to 5% depending on patient and procedural factors[2]. In addition, urinary tract and adjacent organ injuries, although infrequent, contribute significantly to morbidity.[3]

Advances in electrosurgical technology have introduced vessel-sealing systems designed to enhance surgical precision and reduce intraoperative blood loss. LigaSure is an advanced bipolar vessel-sealing device that combines mechanical compression with controlled bipolar energy to denature collagen and elastin, thereby creating a permanent

Contributions:
SZ FZ UU UG NJ - Conception, Design
SZ FZ UU UG NJ - Acquisition, Analysis, Interpretation
SZ FZ UU UG NJ - Drafting
SZ FZ UU UG NJ - Critical Review

All authors approved the final version to be published & agreed to be accountable for all aspects of the work.

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Data Availability Statement: The data supporting the findings of this study are available from the corresponding author upon reasonable request.

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tissue seal. This technology has demonstrated improved hemostatic efficiency and reduced operative duration in various surgical specialties.[4-6]

Recent randomized and observational studies have reported that bipolar vessel-sealing systems are associated with significantly lower blood loss, shorter operative time, and reduced postoperative pain compared with conventional suture ligation in abdominal hysterectomy.[4,5] Comparative studies from Pakistan evaluating electrosurgical bipolar vessel sealing in total abdominal hysterectomy have similarly suggested improved perioperative outcomes.[7,8] However, despite increasing adoption of this technology, prospective comparative data from tertiary-care centers in Pakistan remain limited.

Given the scarcity of region-specific evidence and the potential implications for surgical efficiency and patient safety, this study was conducted to compare perioperative morbidity, hematologic changes, and postoperative recovery between LigaSure vessel sealing and conventional suture ligation in total abdominal hysterectomy.

Materials And Methods

This prospective, comparative study was conducted at Pak Emirates Military Hospital, Rawalpindi, after obtaining approval from the Institutional Review Board (IRB) of Pakistan (Ref. No. ERC/67/2023) from August 2023 to January 2025. Written informed consent was obtained from all participants after explaining the study procedure, potential risks, and benefits.

Participants were women scheduled for an elective total abdominal hysterectomy for benign indications. A convenience sampling technique was employed for this study, as the logistical constraints in the operating theater regarding equipment availability and surgeon scheduling made convenience sampling the most feasible approach. To mitigate selection bias, all consecutive patients meeting the inclusion criteria during the study period were invited to participate, and the two groups were matched for key demographic and clinical characteristics, as shown in Table I. The sample size estimated was 212, which included 106 in each group, calculated by G Power software. For its calculation, we considered a two-tailed t-test of two independent sample means with 95% power and alpha of 0. The Effect size of 0.49 was calculated by Cohen's D formula using the mean of post-operative haemoglobin of similar groups of our parent article.[9]

Group A included patients in whom LigaSure was primarily used for hemostasis of uterine vessels and pedicles during total abdominal hysterectomy.

Group B comprised patients who underwent conventional suturing for the control of bleeding from blood vessels during the procedure.

Inclusion criteria included all females who indicated a total abdominal hysterectomy during the study period. **Exclusion criteria** included patients with diagnosed cardiac, hepatic, or renal dysfunction, Hep B and C positive, a deranged coagulation profile due to any cause, a known autoimmune disorder, pregnancy, and a history of any neoplastic or immunodeficiency syndrome.

Every patient's detailed medical record was reviewed before enrolment, considering inclusion and exclusion criteria. A questionnaire was designed, comprising all our outcomes, and filled out by the residents willing to participate in data collection. A joint session was conducted to make participants of data collection aware of the study criteria. A comprehensive preoperative assessment was conducted for all patients scheduled for total abdominal hysterectomy, including evaluation of age, height, weight, body mass index (BMI), and parity. A detailed medical history, including any history of previous abdominal surgeries, was also recorded before the procedure. During their physical examination, a bimanual and speculum examination was carried out, followed by a transvaginal ultrasound. Further imaging or diagnostic tests were requested when found necessary. Endometrial biopsy samples were also collected from the patients at risk of endometrial carcinoma, presenting with abnormal uterine bleeding. All patients underwent complete blood count and routine biochemical testing before their surgery. Perioperative prophylactic intravenous antibiotic was given before surgery. Abdominal access was gained through a Pfannenstiel incision. Ligaments, vessels, and pedicles were detached before the removal of the uterus. For the conventional abdominal hysterectomy, clamping and cutting were followed by tying with polyglactin suture material. In the LigaSure group, a small jaw instrument was used for clamping and sealing. In post-operative care, intramuscular diclofenac Sodium was given as the preferred postoperative analgesic. Patients were usually followed for 6 weeks post-surgery.

The primary outcome included the intra- and post-operative complications. Intra-operative complications included urinary tract injury and the need for post-operative J stenting, bowel injury, thermal injury of pelvic adnexal organs, and the uterosacral ligament. Post-operative complications covered leukocytosis in blood, nausea, vomiting, fever, dysuria, abdominal distension, constipation, delayed passage of flatus, thromboembolism, hematoma, wound dehiscence, and pneumonia. Secondary outcomes considered as a part of this study were post-operative reduction in haemoglobin and hematocrit, postoperative need for blood transfusion, pain scores, and the need for analgesia on the evening of surgery, on day 1, day 2, and week 6 postoperatively.

Data analysis was done using SPSS version 25. Continuous variables were presented as mean ± standard deviation (SD) and compared using the independent samples t-test, with effect sizes reported as Cohen's d. Categorical variables were frequencies and percentages. Before the quantitative variables' comparison between groups, the normal distribution of data was checked by applying skewness and kurtosis. Comparison between groups for continuous variables was performed using the independent samples t-test. A p-value of less than 0.05 was considered statistically significant. Categorical variables were presented as frequencies and percentages and compared using the Chi-square test or Fisher's exact test, as appropriate, with effect sizes reported as Phi (φ) or Cramer's V. A p-value of less than 0.05 was considered statistically significant. Where applicable, 95% confidence intervals (CI) were calculated.

Results

The study involved 212 participants who underwent a total abdominal hysterectomy. Among 106 women, the electrothermal vessel sealing system (LigaSure) was used, while the remaining 106 underwent conventional suture ligation. The demographic characteristics are shown in Table I. There were no significant differences in age, BMI, and parity between the two groups. The most common indication of abdominal hysterectomy in the population was heavy menstrual bleeding (47.5%), followed by fibroids unresponsive to medical therapy (27.5%) and UV prolapse (25%).

Table 1: Demographic and Clinical Variables of the Participants (n = 212)

Variable	Categories	Frequency (%)	Group A (Ligasure) n=106	Group B (Conventional) n=106	p-value
Age (years)	45–50	45.0	48 (45.3%)	47 (44.3%)	0.92
	51–55	22.5	24 (22.6%)	24 (22.6%)	
	56–60	32.5	34 (32.1%)	35 (33.0%)	
Parity (children)	1–3	65.0	69 (65.1%)	69 (65.1%)	1.00
	4–5	15.0	16 (15.1%)	16 (15.1%)	
	> 5	20.0	21 (19.8%)	21 (19.8%)	
BMI	<25	40.0	42 (39.6%)	43 (40.6%)	0.99
	25–30	47.5	50 (47.2%)	50 (47.2%)	
	>30	12.5	14 (13.2%)	13 (12.3%)	
Comorbidities	Diabetes Mellitus (DM)	20.0	21 (19.8%)	21 (19.8%)	0.99
	Hypertension (HTN)	32.5	35 (33.0%)	34 (32.1%)	
	Both DM and Hypertension	12.5	13 (12.3%)	13 (12.3%)	
	Other Conditions	20.0	21 (19.8%)	21 (19.8%)	
	None	15.0	16 (15.1%)	17 (16.0%)	

Total Participants: 212, Group A (LigaSure): 106 patients, Group B (Conventional Suturing): 106 patients. Demographics: No significant difference in age, BMI, or parity Indications for Hysterectomy: Heavy Menstrual Bleeding: 47.5%, Fibroids (Unresponsive to medication): 27.5%, Uterovaginal Prolapse: 25%.

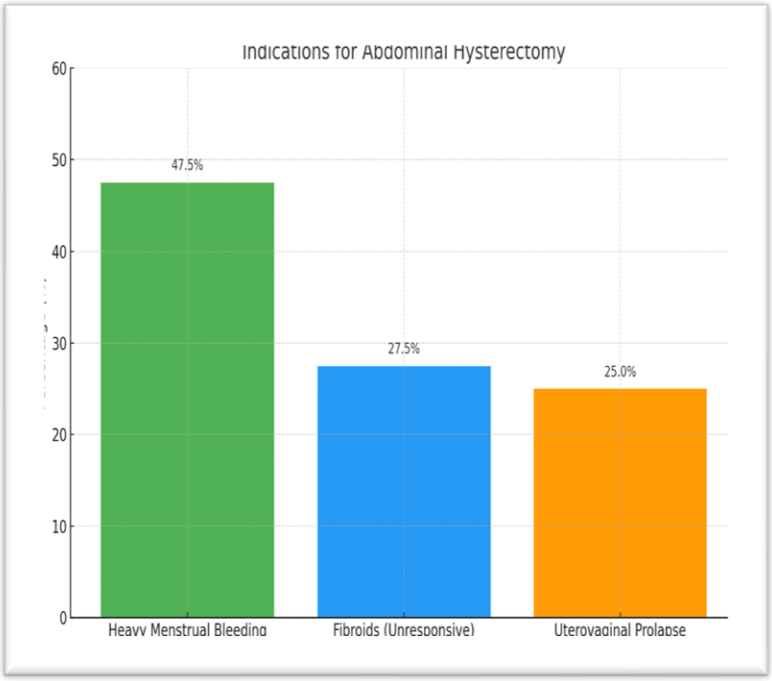

Figure 1: Participant Distribution and Indications for Surgery

The study revealed that the use of Ligasure resulted in a lower incidence of post-op transfusion and use of analgesia as compared to the group that used suture ligation. This difference was indicated by a significant "p" value, as shown in Table 2. The LigaSure group also exhibited a smaller difference between preoperative and postoperative hemoglobin (Hb) and hematocrit (Hct) levels. Additionally, patients in the LigaSure group reported significantly lower postoperative pain scores compared to those in the conventional suture ligation group. A lower incidence of intraoperative and postoperative complications was also observed in the LigaSure group, as presented in Table 2. Notably, there were no cases of bowel injury, injury to pelvic adnexa, postoperative pneumonia, or thromboembolism in either group.

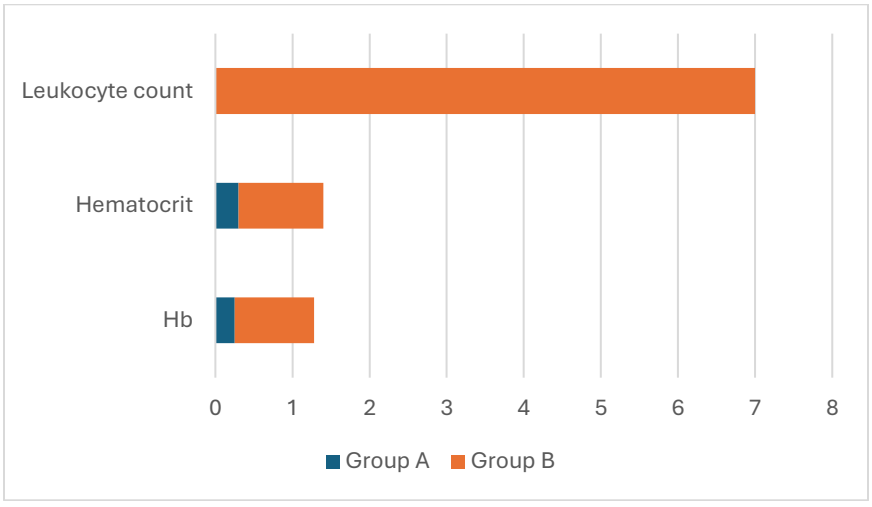

Figure 2: Mean pre and post operative Hemoglobin, hematocrit, and leukocytosis in Group A (Ligasure group) and Group B (Conventional surgery group).

Table 2: Intra-operative and post-operative outcomes' comparison between Ligasure and Conventional ligation in total abdominal hysterectomies (n=212)

S No	Variable	Group A	Group B	p-value	Effect Size (95% CI)
1.	Post op transfusion n(%)	0 (0%)	16 (15%)	<0.001*	φ = 0.31 (0.17 to 0.44)
2.	Post op drain placed n(%)	5 (4.7%)	16 (15%)	0.013*	φ = 0.17 (0.03 to 0.30)
3.	Post op pain (evening of surgery)	Score 5: 35%	Score 9: 75%	0.001*	d = 3.56 (3.11 to 4.01)
		Score 6: 65%	Score 10: 25%		d = 2.67 (2.27 to 3.07)
4.	Mean difference between pre-op and post-op Hb Mean Δ Hb (g/dL), Mean ± SD	0.25 ± 0.1	1.03 ± 0.3	<0.001*	d = 3.56 (3.11 to 4.01)
5.	Mean difference between pre-op and post-op Hematocrit Mean Δ Hct (%), Mean ± SD	0.3 ± 0.2	1.1 ± 0.4	<0.001*	d = 2.67 (2.27 to 3.07)
6	Post op analgesia (day 1) n (%)	80 (75.5)	106 (100)	<0.001*	φ = 0.37 (0.24 to 0.50)
7	Post-op Analgesia (Day 2), n (%)	0 (0)	21 (19.8)	<0.001*	φ = 0.33 (0.19 to 0.46)
8	Intra-operative Complications				
	Urinary tract injury (UTI)	0 (0)	5 (4.7)	0.024*	φ = 0.15 (0.01 to 0.29)
	J stenting	0 (0)	11 (10.4)	<0.001*	φ = 0.25 (0.11 to 0.38)
9	Post-operative Complications				
	Fever	5 (4.7)	11 (10.4)	0.12	φ = 0.10 (-0.03 to 0.23)
	Leukocytosis	0 (0)	7 (6.6)	0.007*	φ = 0.18 (0.05 to 0.32)
	Nausea/Vomiting	12 (11.3)	16 (15.1)	0.42	φ = 0.05 (-0.08 to 0.19)
	Dysuria	0 (0)	12 (11.3)	<0.001*	φ = 0.26 (0.12 to 0.39)
	Constipation	0 (0)	17 (16.0)	<0.001*	φ = 0.30 (0.16 to 0.43)
	Abdominal distension	0 (0)	13 (12.3)	<0.001*	φ = 0.26 (0.12 to 0.39)
	Hematoma	0 (0)	4 (3.8)	0.043*	φ = 0.14 (0.00 to 0.28)
	Wound dehiscence	0 (0)	9 (8.5)	0.002*	φ = 0.21 (0.07 to 0.34)

**Statistically significant (p < 0.05); Δ: Change (Pre-op - Post-op); d: Cohen's d; φ: Phi coefficient for 2x2 tables.*

Discussion

Effective hemostasis remains a fundamental determinant of safety in total abdominal hysterectomy. Excessive intraoperative blood loss can precipitate significant postoperative hemoglobin decline, increase transfusion requirements, and prolong hospitalization, thereby amplifying perioperative morbidity. In the present study, the use of LigaSure was associated with a statistically significant reduction in perioperative blood loss, evidenced by a smaller decline in hemoglobin and hematocrit levels and the absence of postoperative transfusion requirements when compared with conventional suturing techniques.

These findings are congruent with contemporary randomized and observational studies. Dubey et al. reported significantly reduced intraoperative blood loss and lower postoperative pain scores in patients undergoing abdominal hysterectomy with LigaSure compared with conventional suturing.[10] Similarly, Pharande et al. demonstrated shorter operative duration and enhanced postoperative recovery among patients treated with LigaSure.[11] Regional evidence from Pakistan further corroborates these findings, showing reduced operative blood loss and improved perioperative outcomes with bipolar vessel-sealing systems.[12]

Meta-analytic data reinforce this evidence base. In a network meta-analysis evaluating haemostatic strategies for hysterectomy, Guo et al. identified advanced bipolar vessel-sealing systems as among the most effective modalities for minimizing intraoperative blood loss.[13] These results support the underlying physiological mechanism of

LigaSure technology, which provides consistent and reliable vessel sealing through precisely controlled bipolar energy delivery and tissue compression.

Beyond hemostatic advantages, our study demonstrated significantly lower postoperative pain scores and reduced analgesic requirements in the LigaSure group. Comparable findings were reported by Dubey et al., who observed lower pain intensity and shorter hospital stay among patients treated with bipolar vessel-sealing systems.[14] The reduction in tissue handling, minimized lateral thermal spread, and shorter operative duration may collectively account for these improved postoperative outcomes.[15]

Furthermore, our data revealed lower rates of selected intraoperative and postoperative complications in the LigaSure group. Although earlier investigations reported no statistically significant differences in complication rates between electrosurgical and conventional approaches,[16-19] more recent evidence suggests that advanced vessel-sealing systems may positively influence inflammatory and hematologic responses.[6] Toz et al. demonstrated variations in inflammatory markers depending on the energy modality used during hysterectomy,[6] underscoring the potential systemic implications of surgical energy devices.

Importantly, this study provides prospective region-specific data from Pakistan, where comparative literature remains limited. The observed reduction in transfusion requirements is particularly relevant in low- and middle-income healthcare settings, where blood product availability may be constrained, and transfusion-associated risks pose additional concerns. Improved surgical efficiency and shortened hospital stay may also translate into meaningful economic benefits for tertiary-care institutions.

While earlier studies conducted in different surgical contexts reported comparable complication rates between LigaSure and conventional techniques,[16-19] technological advancements and increasing operator proficiency may explain the more favorable outcomes observed in recent investigations.[4,5] Nevertheless, variations in study design, patient demographics, surgical expertise, and perioperative protocols may contribute to heterogeneity across published data. Overall, our findings are consistent with contemporary literature demonstrating that advanced bipolar vessel-sealing systems enhance perioperative outcomes in abdominal hysterectomy.[4-6,12,13] However, large-scale multicenter randomized controlled trials with extended follow-up are required to further substantiate these benefits and to evaluate long-term surgical and cost-effectiveness outcomes.

Several limitations warrant consideration. First, this was a single-center study, which may limit the generalizability of findings to institutions with differing surgical expertise, infrastructure, or perioperative protocols. Second, the use of convenience sampling introduces the potential for selection bias, which may have influenced group comparability despite baseline similarity. Third, follow-up was confined to the immediate perioperative and short-term postoperative period; therefore, long-term outcomes such as adhesion formation, late complications, and symptom recurrence were not assessed. Finally, the observational study design precludes definitive conclusions regarding causality between LigaSure use and improved clinical outcomes.

These limitations underscore the need for rigorously designed multicenter randomized controlled trials with extended follow-up to validate and expand upon our findings. Nevertheless, the present data suggest that LigaSure may significantly improve perioperative parameters, reduce transfusion requirements, and enhance overall surgical efficiency in total abdominal hysterectomy.

Conclusions

The present study demonstrates that the use of the LigaSure vessel-sealing system in total abdominal hysterectomy is associated with significantly improved perioperative outcomes compared with conventional suturing techniques. Specifically, LigaSure use resulted in reduced blood loss, smaller hematologic decline, shorter operative duration, lower postoperative pain scores, decreased analgesic requirements, and reduced complication rates.

These findings indicate that LigaSure represents a safer and more efficient alternative for vascular control during hysterectomy procedures. While additional large-scale, multicenter studies with long-term follow-up are necessary to confirm these results, the current evidence supports the integration of advanced bipolar vessel-sealing technology into routine gynecologic surgical practice.

The clinical significance of this study is particularly pronounced in tertiary-care hospitals within low- and middle-income countries. Adoption of LigaSure technology may enhance operative efficiency, optimize operating room utilization, reduce postoperative morbidity, and contribute to cost-effective surgical care. Integration of advanced vessel-sealing systems into standard practice, therefore, holds potential to improve both patient safety and institutional healthcare performance.

Author Information

1. Professor, PEMH 2. Assistant Professor, PEMH 3. Associate Professor, CMH, Rawalpindi 4. Medical Officer, PEMH, Rawalpindi 5,6. Assistant Professor, CMH, Rawalpindi
Corresponding author: Dr. Fareeha Zaheer drfareehaaqueel@gmail.com

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