

Electrothermal Vessel Sealing a Time Saving Alternative to Classic Suturing in Total Abdominal Hysterectomy; A Retrospective Study

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ABSTRACT

Objective: To analyze efficacy of Electrothermal Vessel Sealing in comparison to Conventional Suture Ligation in Total Abdominal Hysterectomy.

Study Design: Quasi-experimental study

Place and Duration of Study: Department of Obstetrics and Gynecology, Pakistan Emirates Military Hospital Rawalpindi, Pakistan from Aug 2022 to Aug 2023.

Methodology: The quasi-experimental study included one hundred and sixty six participants divided into two groups, Group-I had 83 patients while 83 patients were placed in group-II. Group-I received Ligasure and group-II received conventional suturing while undergoing total abdominal hysterectomy. Primary outcomes included estimated blood loss, pedicle securing time, surgery duration, post-operative NPO and hospital stay. Secondary outcomes involved need for suture ligation in surgeries with Ligasure.

Results: Median age was for group I was 49(7) for Ligasure and 48(5) for conventional suture. Both groups had median BMI of 25(4) and median parity of 4(1). In the Ligasure group, 58(69.9%) participants had TAH, and 25 (30.1%) had TAH and BSO, while in the conventional suture group, 63(75.9%) had TAH and 20(24.1%) had TAH plus BSO. In the Ligasure group, 49.4% of the participants had AUB as the most common indication, whereas in the conventional suture group, 42.2% had leiomyoma. Notably, there was significantly lower blood loss with Ligasure (90 vs. 200 ml, p -value 0.001), as well as a shorter duration of surgery (35 min vs. 65 min, p -value 0.001) and pedicle securing time (10min vs. 35 min p -value 0.001). The postoperative NPO, postoperative mobility, and postoperative hospital stay were all shorter in the Ligasure group.

Conclusion: Ligasure was found to be advantageous over conventional suture in terms of perioperative surgical outcomes for total abdominal hysterectomy.

Keywords: Conventional Sutures, Electrocoagulation, Total Abdominal Hysterectomy

How to Cite This Article: Zohra S, Chohan SF, Najeeb W, Komal N, Mohsin R, Islam A. Electrothermal Vessel Sealing A Time Saving Alternative To Classic Suturing In Total Abdominal Hysterectomy; A Retrospective Study. Pak Armed Forces Med J 2024; 74(6): 1743-1747. DOI: <https://doi.org/10.51253/pafmj.v74i6.12459>

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INTRODUCTION

Hemostasis maintenance is a major intraoperative challenge in all surgeries.¹ Extended surgical procedures could result in increased blood loss leading to hypovolemia, necessitating the need of transfusion. Prolonged stress on the body during surgery may also compromise the immune system, increasing the susceptibility to infections leading to surgical site infections, impaired wound healing and postoperative psychological issues. A recent meta-analysis on prolonged surgical duration concluded that in obstetrics and gynecological surgeries, there is an increase in rate of surgical complication from 2.1% to 29%.² Prolong surgeries result in moderate to severe intensity postoperative pain among patients, which can complicate the recovery process and require

additional management.³ These aforementioned factors increase the healthcare costs because of extended operating time, increased resource utilization, and potential postoperative complications.

It is a challenging factor for every surgical team to monitor and manage the factors contributing to prolonged surgeries and to minimize the associated risks to improve patient outcomes. A major challenge in total abdominal hysterectomies (TAH) is to minimize the potential for complications in achieving hemostasis during the ligation of uterine and ovarian ligaments along with the associated blood vessels. Conventionally hemostasis was typically achieved through Suture ligation. In 1998, a device known as electrothermal vessel sealing system was introduced, utilizing a combination of pressure and bipolar energy to create a seal. Presently, it has application in both laparoscopic and open surgeries. It operates swiftly, with each ligation requiring 2 to 4 seconds.⁴ This

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Received: 15 Jul 2024; revision received: 03 Oct 2024; accepted: 07 Oct 2024

advancement proves very effective in securing vascular pedicles during hysterectomies.

Pakistan being a developing country often faces resource constraints, including shortages of skilled healthcare professionals, including surgeons and anesthesiologists, surgical equipment, anesthesia supplies, and postoperative care resources.⁵ Prolonged procedures significantly impact its quality of patient care. These mentioned significant challenges highlight the importance of developing surgical strategies to minimize duration of surgeries to ensure efficient patient care. In Pakistan and other developing countries, this instrument is exclusively utilized in general surgery.^{6,7} Until recently, it was absent from gynecology and obstetrics tertiary facilities across Pakistan. To gauge the effectiveness and impact of using this instrument in our region, this study was devised with the aim of assessing the efficacy of this device in total abdominal hysterectomy comparing it to conventional suture ligation.

METHODOLOGY

The study was conducted at Department of Obstetrics and Gynecology at a Public Sector Hospital in Rawalpindi, Pakistan. Ethical approval was obtained from Institutional Ethical Review Board (A/28/ERC/543/23). Population of interest included patients who underwent Total Abdominal Hysterectomy either by Conventional Suturing or LigaSure, from August 2022 to August 2023. The participants were divided into two distinct groups. In group-I, Ligasure was primarily utilised for cessation of bleeding from blood vessels (uterine vessels) and uterine pedicles. Group-II comprised of women for whom conventional suturing was mainly considered to secure hemostasis and uterine pedicles as shown in patient flow diagram.

Convenience sampling technique was used for data collection. Sample size was determined by G power software with 83 participants allocated in each group. An estimated effect size of 0.566 was calculated using Cohen's D formula, utilizing the operative time from similar groups of our parent article.⁸

Inclusion Criteria: Women with the indication of total abdominal hysterectomy were included in the study.

Exclusion Criteria: Patients with diagnosed cardiac, hepatic or renal dysfunction, deranged coagulation profile, autoimmune disorder, pregnancy and, history of any non-gynecological neoplastic or immune deficiency syndrome.

The Data collection team comprised of postgraduate resident headed by a consultant in obstetrics and gynecology. They collected the data by reviewing the history, biochemical profile, surgical and postoperative notes of patients enrolled to obtain study outcomes. A questionnaire was designed comprising of study outcomes, any missing information was obtained by reaching out to patients through contacts traced from available medical records.

The hospital's protocol for performing total abdominal hysterectomy required recording various patient details such as age, height, weight, BMI, parity, and history of previous abdominal surgery. A comprehensive medical history was documented prior to the surgery, and a physical examination, including bimanual and speculum exams, in addition to this a transvaginal ultrasound was conducted. Additional imaging or diagnostic tests were only performed if deemed necessary. For patients with abnormal uterine bleeding, endometrial biopsy samples were taken. All patients underwent complete blood count and routine biochemical testing before the surgery. Perioperative prophylactic intravenous antibiotics were administered to all patients. The surgical procedure involved total abdominal hysterectomy with either bilateral salpingoophorectomy or bilateral salpingectomy. Abdominal access was gained through a Pfannenstiel incision, and ligaments and arteries were tied and detached from the uterus. In 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, followed by sealing and cutting. The vaginal cuff was secured with a single-layer continuous running suture. Subcutaneous fat was closed with a subcutaneous approximation suture, and the skin was closed using a 2/0 Prolene suture. Post surgery, primary surgeon put detailed surgical notes comprising of all the surgical outcomes including estimated blood loss, duration of surgery, duration of different components of surgery, any associated complication occurred during surgery with comments on other pelvic organs.

Primary outcome included estimated blood loss, pedicle securing time, duration of surgery, post-operative duration of NPO (Nothing per oral), and post-operative hospital stay. Secondary outcomes involve assessing the necessity for suture ligation in surgeries performed with LigaSure, identifying

instances where the application of Ligasure was not feasible in total abdominal hysterectomies (TAHs).

Data analysis was done using Statistical Package for Social Sciences (SPSS) version 25. Descriptive statistics (median, IQR) and frequencies presented the study data. Prior to quantitative data analysis normal distribution was assessed using skewness and kurtosis which showed data is not normally distributed. Group comparisons for continuous variables were conducted using Mann Whitney U test, while Chi-square test was applied for categorical variables. Statistical significance was set at $p \leq 0.05$.

RESULTS

The study involved 166 participants who underwent total abdominal hysterectomy. Among 83 women, the Electrothermal Vessel Sealing system was used, while the remaining 83 underwent conventional suture ligation. The demographic characteristics are detailed in Table-I. There were no significant differences in age, BMI, and parity between the two groups. Almost 80% of women in both groups had unscarred uteri, indicating that most of them had vaginal deliveries. The size of the uteri was less than 16 weeks in most cases. Around 70-80% of the procedures were total abdominal hysterectomy, and 20-30% of the participants also underwent bilateral salpingo-oophorectomy. The population in both groups significantly differed in terms of comorbidities, with women in the Ligasure group having fewer comorbidities than those in the suture ligation group, as mentioned in Table-I.

In both groups, there was a significant difference in the indications requiring total abdominal hysterectomy, with a p-value of 0.001. In the Ligasure group, 41(49.4%) patients had abnormal uterine bleeding (AUB), 21 (25.3%) had leiomyoma, 9(10.8%) had AUB due to postmenopausal bleeding (AUB-P), 9(10.8%) had uterine malignancy, and 3(3.6%) had adnexal cyst. Among women operated with conventional suturing, 35(42.2%) had leiomyoma, 28(33.7%) had AUB, 7(8.4%) had AUB due to leiomyoma (AUB-L), 5(6%) had postmenopausal AUB (AUB-P), 4(4.8%) had ovarian malignancy, and 4(4.8%) had adnexal cyst.

The study revealed that conventional suture ligation resulted in greater estimated surgical blood loss, longer surgery duration, and longer uterine pedicle securing time compared to the Ligasure group. This difference was indicated by a very low "u" value and a significant "p" value, as shown in Table-II.

Patients who underwent total abdominal hysterectomy with Ligasure also had an earlier return of gut peristalsis and a shorter postoperative duration of NPO. The postoperative bladder catheterization time had a similar median and interquartile range in both groups. However, the statistical analysis also showed a greater "u" value with a significant p-value of 0.001. Finally, participants had significantly earlier postoperative patient mobility and a smaller duration of hospital stay after total abdominal hysterectomy with the use of an electrothermal vessel sealing device. Suture ligation was required to achieve hemostasis in only three patients (3.6%) due to the failed attempt, i.e., ineffectiveness of Ligasure, in the remaining 96.4% of the surgeries it was not needed.

Table-I: Demographic Characteristics of the Patients (n=166)

Variables	Group-I (Ligasure) (n=83)	Group II (Conventional Suture Ligation) (n=83)	p-value
Age: median (IQR)	49(7)	48(5)	0.28
BMI: median (IQR)	25(4)	25(4)	0.53
Parity: median (IQR)	4(1)	4(2)	0.48
History of previous surgery: n(%)	17(20.5%)	10(12%)	0.20
Scarred uterus: n(%)			
Prev 1	6(7.2%)	6(7.2%)	0.17
Prev 2	6(7.2%)	2(2.4%)	
Prev 3	5(6%)	6(7.2%)	
Prev 4	0	3(3.6%)	
Other	0	0	
Not scarred	66(79.5%)	66(79.5%)	
Comorbidities: n(%)			
None	49(59%)	43(41.8%)	0.002
Diabetes mellitus	19(22.9%)	9(10.8%)	
Hypertension	7(8.4%)	22(26.5%)	
Both	5(6%)	9(10.8%)	
Other disease	3(3.6%)	0	
Procedure: n(%)			
Total Abdominal Hysterectomy(TA H)	58(69.9%)	63(75.9%)	0.48
Total Abdominal Hysterectomy and Bilateral Salpingo-Oophorectomy	25(30.1%)	20(24.1%)	
Uterine size: n(%)			
Less than 16 weeks	58(69.9%)	53(63.9%)	0.51
Equal or Greater than 16 weeks	25(30.1%)	30(36.1%)	

Table-II: Perioperative Outcomes Comparison Between Ligasure and Conventional Ligation in Total Abdominal Hysterectomy (n=166)

Variables	Ligasure Median (IQR) (n=83)	Conventional Suture Ligation Median (IQR) (n=83)	p-value
Estimated Surgical Blood Loss (ml)	90(15)	200(50)	0.001*
Duration of Surgery (minutes)	35(6)	65(20)	0.001*
Uterine Pedicle Securing Time (minutes)	10(5)	35(10)	0.001*
Post Operative Nill Per Oral (hours)	12(0)	24(0)	0.001*
Post Operative Bladder Caterterization (hours)	24(0)	24(0)	0.001*
Post Operative Mobility (Hours)	15(1)	24(6)	0.001*
Post Operative Hospital Stay (Hours)	24(0)	48(24)	0.001*

*significant p-values

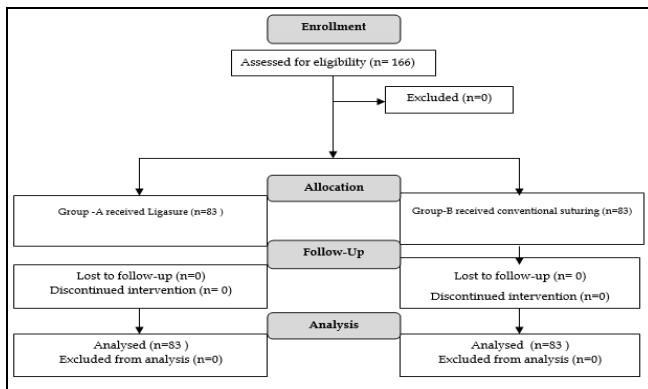


Figure: Patient Flow Diagram

DISCUSSION

The study showed that using Ligasure resulted in significantly lower blood loss compared to conventional sutures in TAH, with a decrease of 110 ml (90 ml vs. 200 ml, $p < 0.001$). The maintenance of hemostasis is a major challenge in surgeries, with extended procedures leading to increased blood loss and potential complications. The use of advanced devices such as the electrothermal vessel sealing system has proven effective in securing vascular pedicles during hysterectomies.⁹⁻¹⁰ However, in

developing countries like Pakistan, there are resource constraints that impact patient care. To assess the effectiveness of such devices, a study is being conducted to compare their efficacy in transabdominal hysterectomy with conventional suture ligation.

Several other studies in the literature support this finding.¹¹⁻¹³ A study by Mohammad *et al.*, in Egypt found a similar difference between groups i.e. 142 ml vs 285 ml,¹⁴ while Bakacak in his study on percreta-associated hysterectomies found blood loss of <50 ml with electrothermal vessel sealing.¹⁵ In addition, peripartum hysterectomies were also associated with decreased blood loss with Ligasure (3198 ml vs. 4223 ml, p -value of 0.02).¹⁶ However, some studies reported contrasting results.¹⁷⁻¹⁹ These studies include those by Ayden¹⁸ and Lopez¹⁹. It is important to note that the observed effect could depend on the size of the uterus being removed, as larger uteri were more likely to result in greater blood loss. Another factor to consider is the measurement of blood loss, which in some studies was based on postoperative hemoglobin reduction.¹⁸

Ligasure led to a significant reduction in operative time (35 min vs. 65 min) and a shorter pedicle securing time (10 min vs. 35 min) compared to traditional suture ligation. These results were backed by multiple studies^{15,18} and were in line with Essadi *et al.*, study in Libya, which reported similar surgical durations (39.6 min vs. 62.7 min).⁹ Furthermore, 66% of patients treated with Ligasure had surgeries lasting less than an hour.¹⁰ However, the study by Türkçüoğlu *et al.*, does not support our findings,¹⁷ possibly due to a smaller sample size. In terms of the seal of Ligasure, around 96.4% of our study's cases were successfully sealed, with only 3.6% requiring sutures. The study by Dubey *et al.*, reported a first seal success rate of 83.3%, with an 8.33% success rate for the second seal, and a seal failure rate of 8.3% requiring sutures,¹² which is slightly higher than our findings.

In terms of hospital stay, it was observed that a 24-hour difference between the two techniques, with Ligasure demonstrating a shorter stay. This aligns with the findings of Wang *et al.*, who noted decreased hospital stays in patients undergoing TAH with Ligasure for cervical cancer.¹¹ However, some studies have shown contradictory results,¹⁰⁻¹⁸ possibly because Singh *et al.*, categorized the effect as less than or more than 6 days, which could be due to complicated cases of both surgeries leading to longer stays.¹⁰ Biochemical inflammatory markers such as CRP, CPK, and WBC

did not show any significant differences with the use of Ligasure.¹⁷ A prospective cohort study by Schilder *et al.*, reported decreased incidence of adverse events in gynecological surgeries done with Ligasure with overall good safety profile.²⁰

In this study, the duration of postoperative NPO, mobility, and postoperative bladder catheterization were significantly shorter with Ligasure compared to traditional methods. There were no comparative studies found in the literature on TAH that directly compared these factors. However, studies did show indirect evidence of decreased postoperative complications with Ligasure, leading to faster recovery.^{9,10}

LIMITATION OF STUDY

It was a retrospective single-centered study with a very small sample size, limiting the generalizability of our findings.

CONCLUSION

The Electrothermal Vessel Sealing was more effective than Conventional Suturing. We observed significant outcomes for Blood Loss, Duration of Surgery, NPO, Mobility and Hospital Stay among patients undergoing Total Abdominal Hysterectomy.

Conflict of Interest: None.

Funding Source: None.

Authors Contribution:

Following authors have made substantial contributions to the manuscript as under:

SZ & SFC : Data acquisition, data analysis, drafting the manuscript, critical review, approval of the final version to be published.

WN & NK: Study design, data interpretation, drafting the manuscript, critical review, approval of the final version to be published.

RM & AI: Conception, data acquisition, drafting the manuscript, approval of the final version to be published.

Authors agree to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

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