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Comparative Study of Bipolar Vessel Sealing Against Standard Suturing in Total Abdominal Hysterectomy

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Abstract:

Background and Purpose: Laser, electrothermal, and ultrasonic coagulation techniques are now preferred in hysterectomy procedures, replacing traditional sutures. The study aims to compare the differences in the postoperative complications and the efficacy of the electrosurgical bipolar vascular sealing system (BVSS) and conventional suture ligatures. **Materials and Methods:** In a prospective study, women referred for total abdominal hysterectomy (TAH) due to different benign causes were randomized to the BVSS group (n=28) or the conventional suture ligature TAH group (n=24). The main outcome indicators included duration of operative time, blood loss, pain level, hospital stay, as well as complications of operation.

Results: The results showed that the BVSS approach was associated with less blood loss during surgery (P=0.0008), lower reduction in hemoglobin levels after surgery (P<0.0001), and short duration of operative time (P=0.0400). Both groups exhibited similar outcomes in terms of drainage volume, postoperative fever, incision length, and duration of hospital stay, with no significant differences observed. Regarding pain scores, the conventional surgery group had lower levels of postoperative pain within 24 hours compared to the BVSS group (P= 0.0230), without significant differences throughout the next 48 hours.

Conclusions: Bipolar vascular sealing reduces blood loss and operation time in abdominal hysterectomy for benign diseases. Further research with larger patient populations is needed to assess other postoperative complications and cost-effectiveness.

Keywords: *Blood Vessel Sealing System (BVSS), Conventional Sutures, Total Abdominal Hysterectomy.*

Introduction:

Hysterectomy is a frequently offered serious gynecological treatment used to address various gynecological conditions, including gynecologic malignancy, fibromyomas, endometriosis, prolapsed uterus, chronic pelvic pain, and abnormal vaginal bleeding (1,2). Over time, minimally invasive techniques like vaginal, laparoscopic, and robotic

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hysterectomy have gained popularity and mostly replaced the traditional total abdominal hysterectomy. Vaginal hysterectomy remains the gold standard, while laparoscopic and robotic hysterectomies are increasingly preferred and offer various options (2,3). In recent years, laser applications, electrothermal coagulation, and ultrasonic coagulation techniques have replaced traditional suture ligation methods in gynecological surgeries (4). Electrothermal coagulation is a technique that employs high-power current to dissolve elastin and collagen in tissue, firmly fusing vascular layers and shutting vessels with 2-7 mm diameter (5). The collagen and elastin strands in the compacted vascular layers are altered; during the cooling period, crosslinking occurs, effectively producing a new, solid layer of collagen and elastin tissue (6).

Electrosurgical forceps are commonly used in open surgical operations to grip, dissect, and clamp tissue. They utilize electrical energy and mechanical clamping to coagulate, cauterize, and seal tissue by heating blood vessels and tissue (5). LigaSureTM uses a mix of stress and continuous bipolar energy to seal vessels effectively. It applies high, consistent mechanical compression while monitoring and regulating the delivery of energy (6). Bipolar electrosurgical forceps consist of two electrodes positioned on the inner surfaces of the end effectors, both connected to an electrosurgical generator. Each electrode has a different electric potential. When the forceps grip tissue between the electrodes, electrical energy is delivered through the tissue, taking advantage of its conductivity (7). Precise management of pressure and electrode gaps is essential for effectively sealing larger vessels. The procedure can successfully seal vessels with a 7 mm diameter, and the resulting seal can withstand pressures up to three times the average systolic pressure (8,9). This study aims to compare the blood loss, incision size, operation duration, uterine weight, and hospitalization duration between the BVSS and the standard suturing in TAH.

Materials and methods:

In a prospective randomized controlled study, women referred for TAH due to various benign causes were arbitrarily selected for either the BVSS group (n=28) or conventional suture ligature TAH group (n=24). These women were referred to Nu'man Teaching Hospital and several private hospitals in the Al-Karkh area of Baghdad between July 2022 and January 2023. The main result indicators included duration of operative time, hospital stay, loss of blood, pain level, and perioperative and postoperative complications. Patient information was prospectively collected.

The Institutional Review Board or Ethics Committee at Al-Iraqia University's College of Medicine approved the study (FM.SA/212). Before participating in the trial, all subjects gave their informed consent.

A total sample of 52 women was involved in this study as they prepared for subjecting to TAH with bilateral salpingo-oopherectomy for benign disease including multiple uterine fibroids, abnormal vaginal bleeding, endometriosis, and chronic pelvic pain. 24 women decided to have conventional surgical suturing while the other 28 women decided to have BVSS. The sample size was determined according to the availability of the cases in the previously mentioned centers.

All women included in this study were candidates for TAH as they all indicated this type of surgery; they were multiparous with no chronic disease. Patients with cancer, those who had undergone surgery by a non-gynecology specialty, and patients who were scheduled for operation with other than the specified study devices were excluded.

This study comprised three phases. During the initial phase, a questionnaire was created to gather sociodemographic information (age, parity, education level, BMI), medical history, history of previous abdominal surgery, chief complaint, and information about the indication for TAH.

Transvaginal ultrasonography (TV US) was performed as part of the medical evaluation, along with any additional diagnostic or imaging tests that were deemed necessary. Endometrial biopsy specimens were taken from patients with abnormal uterine hemorrhage, and all patients underwent laboratory tests.

The second phase of the study focused on the perioperative period of TAH. Intravenous prophylactic antibiotics (ceftriaxone 1g) were administered. A transverse (Pfannenstiel) incision was used to perform a TAH with Type-1 bilateral salpingectomy or bilateral salpingo-oophorectomy. In the conventional abdominal hysterectomy group, clamping, cutting, and tying with polyglactin suture material (Vicryl size: 1) were utilized. The second group employed the LigaSure TM small jaw instrument (LSJI; Medtronic, Boulder, CO, USA) method, which involved sealing and cutting after clamping. Variables such as incision length, blood loss during surgery, and duration of surgery were assessed during the operation.

The last phase involved observing variables immediately after surgery, including postoperative pain and hospital stay. Blood loss estimation techniques included direct measurement and gravimetric techniques. Postoperative blood loss was calculated using an intraperitoneal suction drain. The total blood loss, comprising intraoperative and postoperative losses, was recorded to determine the overall blood loss

Statistical Analysis:

The data was gathered, calculated, and processed using SPSS (Version 23.0). Analysis of variance was utilized for assessing quantitative variables, while the Student's t-test was employed for assessing the two groups. Mean ± standard deviation and percentage were used to express all data. A statistically significant test result was noted when $P \leq 0.05$.

RESULTS:

Table one demonstrates the pattern of women according to the indication for TAH+BSO.

The main indication in both groups (75% and 70.83% respectively) while abnormal uterine bleeding was the second most common cause (17.86% and 16.67% respectively), endometriosis and chronic pelvic pain were considered for (3.57%) for each one in BVSS group and (8.33%) and (4.16%) in conventional surgery group (Table 1).

Significant statistical differences were found in the reduction of hemoglobin levels after surgery (P<0.0001), as well as in the hemoglobin levels at 8 hours (P=0.0038) and 24 hours (P=0.0418) postoperatively. There was also a significant statistical difference in the estimated blood loss during surgery (P=0.0008). BVSS shows a significant reduction in the duration of surgery from skin opening to skin closure compared to the conventional group (p=0.0400), illustrated in Table 2.

At 24 postoperatively, the Conventional surgery group showed substantially lower VAS pain levels than the LigaSure group (p = 0.0230), throughout the next 48 hours the pain score with the conventional surgery group remained lower than the BVSS group but without statistical significance Table 3.

Table -1- Indication for hysterectomy

	BVSS (No.=28)	Conventional surgery (No.=24)
	No. (%)	No. (%)
Uterine Myoma	21 (75%)	17 (70.83%)
Endometriosis	1 (3.57%)	2 (8.33%)
Abnormal Uterine Bleeding	5 (17.86%)	4 (16.67%)
Chronic pelvic pain	1 (3.57%)	1 (4.16%)

Table -2- Comparison of operative and perioperative outcomes			
	BVSS (No.=28)	Conventional surgery (No.=24)	P-value
Preoperative hemoglobin (g/L)	11.68 ± 2.13	12.01 ± 1.24	0.5074
Postoperative 8 h hemoglobin (g/L)	11.23 ± 1.21	10.17 ± 1.31	0.0038
Postoperative 24 h hemoglobin (g/L)	10.91 ± 1.14	10.02 ± 1.89	0.0418
Hemoglobin Reduction (g/L)	0.37 ± 1.09	1.9 ± 1.02	< 0.0001
Total estimated blood loss (mL)	350.5 ± 75.5	425.75 ± 75.25	0.0008
Amount of drain (mL)	100.25 ± 35.75	115.35 ± 45.15	0.1846
Postoperative fever	25 (89.29%)	17 (70.83%)	0.0954
Uterine weight in gm	278.5 ± 65.80	275 ± 75.35	0.8588
Incision Length (cm)	12.5 ± 3.35	13.65 ± 3.75	0.2484
Operative Time (min)	57 ± 18	69 ± 23	0.0400
Duration of Hospitalization (days)	2 ± 1.8	2 ± 2.9	1.0000

Table -3- Postoperative pain scores			
	BVSS (No.=28)	Conventional surgery (No.=24)	P-value
Postoperative 24 h	28 (4.1 ± 1.2)	24 (3.4 ± 0.9)	0.0230
Postoperative 48 h	27 (2.6 ± 2.3)	20 (1.7 ± 1.4)	0.1014
Postoperative 72 h	21 (1.3± 1.5)	19 (1.1 ± 1.3)	0.6127

Discussion

A prospective, randomized clinical trial was conducted to assess the effectiveness and safety of the BVSS compared to standard suture ligature. BVSS has demonstrated effectiveness and safety, offering potential advantages over traditional techniques, including reduced postoperative pain, decreased blood loss, short duration of operating and hospital stays time (10). The LigaSure device is a bipolar vessel sealing system that is designed to seal large tissue bundles and 7 mm diameter blood vessels. It minimizes blood loss while providing a reliable sealing alternative that does not affect the risk of surgical complications (11).

In line with the current study, our findings indicate significantly reduced blood loss and lower hemoglobin reduction compared to the conventional surgery group. These results are consistent with several prior studies, further reinforcing the consistency and reliability of these findings across multiple research investigations (12-15). However, it is important to note that our findings differ from the results of other studies (16-18) which have claimed that a bipolar vascular sealing device has little impact on operating room blood loss.

Our findings demonstrated a significant reduction in operation time when using BVSS compared to the conventional surgery approach, which aligns with expectations. BVSS facilitates accelerated surgeries by enabling ligation in a single step, eliminating the need for clamping, cutting, and suturing. These results are consistent with previous studies that have also reported similar findings (16-17).

For the pain score after surgery, we found that at 24 postoperatively, the Conventional surgery group showed substantially lower VAS pain levels than the LigaSure group, throughout the next 48 hours the pain score with the conventional surgery group remained lower than the BVSS group but without statistical significance. This result follows Chyi-Long et al (17,18) who found that compared to the LigaSure, significantly decreased VAS pain levels of the conventional device group at 24 h (p 0.006) and 36 h postoperatively (p 0.002). The findings of the current study contradict the findings of Sameer et al. (8), who reported statistically significantly higher postoperative pain in the conventional group during the first 3 days post-surgery compared to the vessel sealing group. Despite the pain difference no longer being statistically significant, the conventional group continued to experience increased pain from days 4 to 7 following surgery.

In line with previous studies (8,16,19), our findings show no statistically significant differences in incision length or duration of hospitalization between both groups. However, it should be noted that another study reported a shorter total hospital stay in the BVSS group compared to the alternative approach (12).

Conclusion:

According to the findings, it can be concluded that Bipolar vascular sealing appears to be linked to less blood loss and reduction in operation time when used during abdominal hysterectomy for benign diseases.

Ethical approval:

The Institutional Review Board or Ethics Committee at Al-Iraqia University's College of Medicine approved the study (FM.SA/212). Before participating in the trial, all subjects gave their informed consent

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Conflict of interest

The authors declare that they have no competing interests.

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