

COMPARISON BETWEEN THREE INSTRUMENTS FOR TOTAL LAPAROSCOPIC HYSTERECTOMY: HARMONIC SCALPEL, LIGASURE, AND BIPOLAR SHEARER

Rakesh A Hasabe¹, Mangesh Hivre², Shrutika Khapre³

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Corresponding Author:

Dr. Rakesh A Hasabe

Email: rakesh.hasabe@gmail.com

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¹Assistant Professor, Department of Obstetrics and Gynaecology, BKL Walavalkar Rural Medical College, A/P-Kasarwadi, Chiplun, District -Ratnagiri.

²Assistant Professor, Department of General Surgery, MGIMS, Sewagram, Wardha.

³Assistant Professor, Department Obstetrics and Gynaecology, DMIHER Sawangi (Meghe), Wardha.

Abstract

Background: The potential benefits of laparoscopy as a minimally invasive procedure are increased by the relatively new electrothermal bipolar vessel sealer technology, which facilitates efficient thermal sealing of vessel walls with enhanced efficiency and minimal lateral spread.^[1] While several such options are available to achieve the mandated standards of minimally invasive TLH, in this study we aim to compare three different instruments, the harmonic scalpel, LigaSure, and the bipolar shearer in terms of their advantages, deficits, and efficacy in performing this laparoscopic procedure. **Materials and Methods:** Ninety willing participants were split into three groups and randomly assigned to receive either TLH with a harmonic scalpel (group A), TLH with a LigaSure (group B), or TLH with a bipolar shearer (group C). Thirty envelopes were assigned to each method. Each envelope contained a notecard indicating one of the three techniques used in the study. The ninety identical, sealed envelopes were safely stored by the researchers. Just before surgery, the circulating nurse was instructed to choose any envelope. **Results:** Our study revealed significant reduction in operative time using LigaSure (54.36 minutes) compared with both bipolar shearer (59.34 minutes) and harmonic scalpel (68.25 minutes), making it the fastest energy device for completing TLH. The harmonic had more intraoperative bleeding as compared to other instruments, while LigaSure presented with the least amount of bleeding. Though the basic electrothermal principle remains the same for both, bleeding was more with bipolar shearer compared to LigaSure. Complications reported pertain to bleeding from large vascular stumps or uterine vasculature during the procedure. None of the patients required a laparotomy due to stump bleeding. **Conclusions:** LigaSure and the bipolar shearer appear to provide good control of stump sealing than with the harmonic scalpel technique, contributing significantly to less blood loss and a shorter operating time during TLH.

INTRODUCTION

Current global standards of surgical practice mandate employing the least invasive surgical method with a view to minimizing postoperative complications and expedite recovery.^[1,2,3] One of the most common procedures in gynaecological practise is the hysterectomy, total laparoscopic hysterectomy (TLH) is fast becoming the most sought-after standard of treatment.

The most critical and challenging steps during a TLH are the division of the uterine vessels, bladder dissection, and colpotomy, and besides operative

skill, the instrument used plays a pertinent part in ensuring reducing tissue injury, minimizing postoperative adhesion, and preventing inflammation.^[4,5] Studies show that the temperature at the incision site is linked to postoperative adhesion.^[6] Electro surgery presents with limitations in terms of adhering to minimally invasive surgery standards in terms of tissue dissection and coagulation, leading to the advent of high frequency ultrasound energy in open as well as laparoscopic surgery.^[7,8,9,10] The potential benefits of laparoscopy as a minimally invasive procedure are increased by the relatively new electrothermal bipolar vessel sealer technology, which facilitates efficient thermal

sealing of vessel walls with enhanced efficiency and minimal lateral spread.^[11]

While several such options are available to achieve the mandated standards of minimally invasive TLH, in this study we aim to compare three different instruments, the harmonic scalpel, LigaSure, and the bipolar shearer in terms of their advantages, deficits, and efficacy in performing this laparoscopic procedure.

MATERIALS AND METHODS

This study was a randomized clinical trial conducted with institutional review board approval in the Department Obstetrics and Gynecology at BKL Walavalkar Rural Medical College, Chiplun, Maharashtra from April 2020 to April 2022.

All patients posted for TLH were approached to seek participation in the study. The patients signed the informed consent form knowing they had an equal chance of being assigned to any one of the three trial groups and were informed of the available treatment options. They were counseled regarding the right to refuse participation and the right to choose a desired treatment instead of participating in the study. After receiving informed consent, each participant was subjected to a clinical history, clinical examination, per abdominal examination, per vaginal examination, cervical Pap smear, and ultrasound (USG) examination.

Ninety willing participants were split into three groups and randomly assigned to receive either TLH with a harmonic scalpel (group A), TLH with a LigaSure (group B), or TLH with a bipolar shearer (group C). Thirty envelopes were assigned to each method. Each envelope contained a notecard indicating one of the three techniques used in the study. The ninety identical, sealed envelopes were safely stored by the researchers. Just before surgery, the circulating nurse was instructed to choose any envelope.

Inclusion Criteria

1. Adult female
2. Eligible for TLH upon clinical decision by consulting gynecologist

Exclusion Criteria

1. Patients with a history or current diagnosis of gynecologic cancer
2. Uterus size greater than 12-week pregnancy, indicative of any uterus or uterine pathology which is palpable abdominally
3. Any contraindication for laparoscopic surgery
4. Positive Pap smear

The same surgeon and surgical team performed each operation per standard practise. TLH was performed using the novel "Chiplun" technique described herein.

One 10 mm supraumbilical port and two to three additional 5 mm secondary ports, as needed, totaled at least three and, in some cases, four laparoscopic ports used by the surgeon. If necessary, the fourth

port was put there to lift the bladder. Veress needles were used in each case to achieve pneumoperitoneum. Following successful insufflation, the abdomen and pelvis were thoroughly examined. Particular focus was placed on the ureter's anatomy, the existence or absence of adhesions or pelvic pathology, any injuries brought on by the needle or the trocars, and the viability of the procedure. TLH in all cases was started by cutting round ligament and other cornual structures like the fallopian tube and ovarian ligament. Managing the cornual structures was followed by the extended "P" cut, which extends from the ipsilateral round ligament to the apex of contralateral round ligament. After completing extended "P" cut, the next step was to perform the "A" cut, which is congruent with bladder dissection, extending from the ipsilateral round ligament to contralateral round ligament. After completing both "P" and "A" cuts, the ipsilateral uterine artery was coagulated and uterine artery pedicle was lateralized. Colpotomy was performed posteriorly at the apex of uterosacral ligament and was extended circumferentially. Nearly two-thirds of the colpotomy was completed before moving to the contralateral cornual structures. Similar steps were followed to manage the contralateral cornual structures and uterine artery. Colpotomy was thus completed and uterus detached from the vaginal vault. The excised uterine specimen was removed using the morcellator or through the vaginal introitus. Vault closure was completed using Vicryl 1-0 with continuous interlocking sutures. Hemostasis was established, and isotonic saline solution was used to wash the peritoneum. The peritoneum was then deflated, and entry site incisions were stitched and closed. Six hours after the operation, the self-retaining Foley's catheter was removed.

Post-operative care included

- A complete blood count is performed 24 hours following surgery.
- Oxygen saturation and vital signs, including temperature, pulse rate, respiratory rate and blood pressure, are monitored every hour for the first six hours, and every six hours thereafter.
- Blood loss is calculated by comparing the decrease in haemoglobin concentration to the presurgical value.
- Hospital stay calculated from the time of transfer to the operating room until the time of discharge.

RESULTS

This study included 90 patients divided evenly into three groups. Group A included 30 patients who underwent TLH using the harmonic scalpel, group B included 30 patients who received LigaSure, and group C had 30 patients who received bipolar shearer. All patients had routine procedures with no noted complications altering the intervention. The following table demonstrates the study results.

	GROUP A (HARMONIC SCALPEL) N=30	GROUP B (LIGASURE) N=30	GROUP C (BIPOLAR SHEARER) N=30
OPERATIVE TIME (AVG TIME IN MINUTES)	68.25	54.36	59.34
HB DROP % (PREOP TO POSTOP)	2.15	1.26	1.54
HEMATOCRIT DROP % (PREOP TO POSTOP)	2.35	0.64	0.75
HOSPITAL STAY (NO. OF DAYS)	1.84	1.35	1.60
COMPLICATIONS (NO. OF CASES WITH SIGNIFICANT INTRAOPERATIVE BLOOD LOSS)	6	4	5

Our study revealed significant reduction in operative time using LigaSure (54.36 minutes) compared with both bipolar shearer (59.34 minutes) and harmonic scalpel (68.25 minutes), making it the fastest energy device for completing TLH. Although the bipolar shearer works on the same principle as LigaSure, it required more time in comparison to LigaSure but was still significantly faster than the harmonic scalpel.

Blood loss during surgery was considerably less in group B. (1.26%; 0.64%) and group C (1.54%; 0.75%) as compared to group A (2.15%; 2.35%) demonstrated by a significantly greater drop in respective hemoglobin and hematocrit values in Group A compared to the other two groups. This shows that harmonic had more intraoperative bleeding as compared to other instruments, while LigaSure presented with the least amount of bleeding.

The incidence of complications was greater in group A (6 cases) than in groups B (4 cases) and C (2 cases) (5 cases). Though the basic electrothermal principle remains the same for both, bleeding was more with bipolar shearer compared to LigaSure. Complications reported pertain to bleeding from large vascular stumps or uterine vasculature during the procedure. None of the patients required a laparotomy due to stump bleeding. Additionally, Group A spent more time in the hospital than Groups B and C. This is explained by Group A's more frequent instances of bleeding from stumps

DISCUSSION

Depending on the mode, application time, and power setting, each coagulation device has a unique thermal spread. When used for 1 second in monopolar mode, the spread is 3.5 mm, but after 2 seconds, it has increased to more than 20 mm. Thermal spread in bipolar mode is 2.2 mm for 1 second and 3.6 mm for 2 seconds. Thermal spread for PK and LigaSure is 3.9 mm and 2.8 mm, respectively. The thermal spread for ultrasound is 2.9 mm.^[12]

The active titanium blade of the ultrasonic harmonic transducer vibrates (55000 cps high frequency) thus mechanically breaking down protein in tissues to coagulate fluid. Tissue and vessel sealing depends on the power setting and pressure exerted. The harmonic scalpel operates between 50 and 100 degrees Celsius, whereas other devices operate between 150 and 400 degrees Celsius, which results in dessication and charring. LigaSure technology uses bipolar energy accurately to fuse the naturally-occurring collagen and elastin in vessel walls by exerting pressure, efficaciously sealing vasculature 1 to 7 mm in diameter with minimal adhesion, scorching, or thermal spread.^[13,14,15,16]

According to Campagnacci et al. LigaSure is both safer and more effective at sealing blood vessels during colorectal laparoscopy than harmonic. Utilizing the LigaSure reduced blood loss and had marginally greater benefits in terms of operating time and postoperative hospital stay.^[17] According

to a 2007 study by Demirturk et al. comparing the use of harmonic scalpels and electrothermal bipolar vessel sealers in TLH, harmonic scalpels were more time-consuming and caused more bleeding.^[18] The LigaSure and bipolar shearer groups fared significantly better in our study than the harmonic scalpel group in terms of procedure time and estimated blood loss. We speculate that the apparent difference in operation time from that reported by Demirturk et al.^[18] may be due to the surgical teams' varying levels of technical proficiency and operative experience.

Our research showed that there was much less blood loss during TLH where we used LigaSure and Bipolar shearer to perform TLH as compared to harmonic. We hypothesize that this is due to the limitation of the harmonic to manage the bigger vasculature of infundibulo-pelvic and uterine stumps. In a few patients, the source of bleeding was identified as uterine vasculature that was insufficiently sealed by the harmonic, resulting in increased blood loss and time required to stop bleeding. Additionally, we observed that the harmonic scalpel took longer than LigaSure to complete the coagulation-cut cycle in each pedicle. but recording the time difference in each instance was beyond the established protocol of this study. On the other hand, the bipolar shearer did not have any alarm system to denote the adequate coagulation of the tissue and it entirely depended upon the operating surgeon to stop coagulating. However, it was still able to demonstrate better results compared

with harmonic scalpel with respect to operating time, blood loss and percent drop in hemoglobin and hematocrit values. The longer length of hospital stay in the harmonic group as compared to the other two groups is congruent with the Demirturk et al. study.^[18]

Though LigaSure and bipolar shearer had decreased incidence of intraoperative blood loss, during surgery bleeding stumps were noticed in 4 out of 30 (13.33%) patients in the LigaSure group, and in 5 out of 30 (16.66%) patients in the bipolar shearer group, while the harmonic scalpel group had significant intraoperative bleeding in 6 out of 30 cases (20%). An important point to note here was that the operating surgeon in all 90 TLH cases was extensively trained on harmonic scalpel but needed time to develop equal skill with the operating principles of LigaSure and bipolar shearer. The instances of bleeding from uterine stumps in the LigaSure and bipolar shearer groups were noted in the first few cases when the surgeon was still familiarizing himself with the technique. However, bleeding instances curbed once skill was established.

CONCLUSION

LigaSure and the bipolar shearer appear to provide good control of stump sealing than with the harmonic scalpel technique, contributing significantly to less blood loss and a shorter operating time during TLH.

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