

Comparative Analysis of Vaginal Cuff Dissection Outcomes in Laparoscopic Hysterectomy: Monopolar Hook vs. Harmonic Scalpel

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Abstract

Introduction: This study aimed to compare the outcomes of vaginal cuff separation using monopolar hook or harmonic scalpel in laparoscopic hysterectomy.

Materials and Methods: A retrospective analysis was conducted on 210 women who underwent laparoscopic hysterectomy between 2022 and 2024. A total of 105 cases for each surgical method were randomly selected from patient records. Demographic and clinical data were extracted from medical records and analyzed using IBM SPSS version 26. P-value < 0.05 was deemed as statistically significant.

Results: The mean age in the harmonic and monopolar groups was 24.76 (± 5.41) and 25.75 (± 4.64) years, respectively. There were no statistically significant differences between the groups in terms of age, BMI, hospitalization, history of previous abdominal surgery, preoperative hemoglobin levels, and hormone therapy ($P > 0.05$). The mean postoperative hemoglobin level in the harmonic group (11.83 ± 1.26) was significantly higher than in the monopolar group (9.04 ± 1.13) ($P < 0.001$). The average duration of vaginal cuff separation was significantly shorter in the monopolar group (22.24 ± 4.59) compared to the harmonic group (28.70 ± 5.93) ($P < 0.001$). Postoperative complications, particularly vaginal lacerations, were less frequent in the harmonic group (45.7%) than in the monopolar group (60%) ($P = 0.015$). The incidence of incidental findings, especially endometriosis, was lower in the harmonic group (12.4%) compared to the monopolar group (23.8%) ($P = 0.031$). No cases of vaginal cuff dehiscence were observed in either group.

Conclusion: This study demonstrated that vaginal cuff separation using harmonic scalpel in laparoscopic hysterectomy is associated with better outcomes compared to monopolar hook.

Keywords: Vaginal cuff separation, Laparoscopic hysterectomy, Monopolar hook, Harmonic scalpel, Postoperative complications

Introduction

Hysterectomy is one of the most common surgeries in the world, and is the second most frequently performed surgery in the US after cesarean section. The procedure involves removing the uterus and usually the cervix from the body. Hysterectomy is performed to treat conditions such as benign diseases, malignant tumors, postpartum complications, and gender reassignment (1). This surgery is the only intervention that can permanently relieve the symptoms in some patients. However, hysterectomy is associated with certain complications that can affect women's quality of life and life expectancy. Patients may experience physical and mental disorders after this surgery (2).

Hysterectomy, as the most common gynecological surgery, is performed through various methods, including abdominal, vaginal and minimally invasive (laparoscopic). The prevalence of this intervention may vary from one

region to another. For instance, in Germany 2.1 to 3.6 per 1,000 women and in the United States 5.4 per 1,000 women undergo hysterectomy (3,4). In Iran, the prevalence of hysterectomy is 0.37 per 100 births (5).

The main indication for hysterectomy in many studies is uterine leiomyoma. Due to the desire for less invasive surgeries, various methods have been proposed for laparoscopic hysterectomy, including laparoscopic

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vaginal hysterectomy and laparoscopic abdominal hysterectomy (6). These methods can be performed as total or subtotal, in which the cervix is preserved (7). The use of these methods can lead to a reduction in the duration of hospitalization, faster recovery and earlier return to normal activities. However, there are concerns about the rate of cuff dehiscence in laparoscopic and robot-assisted surgeries (8). Some surgeons consider this complication to be caused by the thermal damage of electrosurgical instruments, which can lead to necrosis and vascular damage (9).

Choosing the type of surgery depends on the patient's pelvic condition, clinical examinations and ultrasound, as well as the history of previous surgeries and the expertise of the surgeon (10). Some believe that removing the cervix might reduce libido, increase surgical complications and result in vaginal constriction. Indications for subtotal hysterectomy include endometriosis, anterior and posterior choledochal obstruction, cesarean section, and hysterectomy with concerns about sexual activity. In total hysterectomy compared to subtotal, more vessels and nerves are cut and adjacent organs are more affected (11).

Laparoscopy has been used as a diagnostic method in gynecological surgeries before hysterectomy. The practice of laparoscopic electro surgery has become more prevalent with the advent of tools such as monopolar hooks (12). This technique facilitates homeostasis by using electrical energy between two electrodes. The disadvantages of this method, including thermal damage and smoke production, have led to an ongoing search for developing more efficient tools (13). One of these tools is the harmonic scalpel, which vibrates at 55.5 kHz and causes three synergistic effects including scalpel cavitation, coagulation and cutting to achieve effective hemostasis and tissue dissection. Harmonic scalpel has been clinically approved for occluding vessels larger than 5 mm in diameter (14).

Despite the advantages of harmonic method, limited studies in Iran have compared these two methods in separating the vaginal cuff in laparoscopic hysterectomy. The present study was designed and implemented with the aim of comparing the results of vaginal cuff separation by monopolar hook or harmonic scalpel in laparoscopic hysterectomy.

Methods

Participants

The current research is a retrospective study that was designed and implemented on 210 women undergoing laparoscopic hysterectomy surgery referred to a third-level hospital in the north of Tehran between 2022 and 2024. The studied population included all women who were candidates for laparoscopic hysterectomy surgery at this hospital during the mentioned timeframe.

Eligibility criteria

From the cases of patients who underwent laparoscopic hysterectomy with monopolar hook, 105 cases were randomly selected. Similarly, from the files of patients who underwent laparoscopic hysterectomy with harmonic scalpel, 105 files were randomly selected. Inclusion criteria included 1) women aged ≥ 18 years, 2) having a surgical DVD, and 3) complete medical records. Exclusion criteria included incomplete and illegible files.

Data collection

The data collection tool was a checklist including the variables of age, body mass index (BMI), history of previous abdominal surgery, hemoglobin level before and after surgery, complications after surgery, time of vaginal cuff removal, length of hospital stay after surgery, and incidental findings. Data was extracted from the patients' files by screening the archived clinical records.

Statistical analysis

The collected data was analyzed using IBM SPSS 26.0 software. Firstly, the qualitative (frequency and relative frequency) and quantitative (mean and standard deviation) variables were reported. For statistical analysis, Kolmogorov-Smirnov test was used to measure the normality of the distribution of the investigated variables. For variables with normal distribution, the independent sample T-test was used to compare the average of each of these variables in two groups. For variables without normal distribution, the Mann-Whitney U test was used. Chi-squared test or Fisher's exact test was adopted to compare qualitative variables between the two groups, and a significance level of less than 0.05 was considered ($P < 0.05$).

Ethical considerations

Prior to data collection, informed consent was obtained from all patients involved in accordance with institutional guidelines and ethical standards. Measures were taken to ensure patient confidentiality and data anonymization during the extraction and analysis processes. Ethical approval for the study protocol was obtained from the appropriate institutional review board (IRB), affirming compliance with ethical principles outlined in the Declaration of Helsinki and local regulations (Approval ID: IR.SBMU.MSP.REC.1403.066). Patient privacy and confidentiality were rigorously upheld throughout the study, with data accessed and used solely for research purposes under strict adherence to ethical guidelines.

Results

In the present study, 210 women undergoing laparoscopic hysterectomy surgery who had referred to a tertiary hospital in northern Tehran between 2022 and

2024 were investigated. Of these, 105 people underwent laparoscopic hysterectomy using harmonic scalpel (n=105) and another 105 underwent laparoscopic hysterectomy using monopolar hook (n=105). Demographic data in patients are summarized in Table 1. The patients had a mean age of 25.24 ± 5.05 years, with the harmonic group being younger than the monopolar group (24.74 ± 5.41 vs. 25.75 ± 4.64). However, the age difference between the two groups was not significant ($P=0.111$). Regarding the low age of hysterectomy in the two groups, it should be noted that we selected transgender patients without a history of childbirth as samples. By including transgender patients, the two groups were almost matched in terms of some confounding variables such as the history of myoma, adenomyosis, uterine size, and uterine weight. The mean BMI in the harmonic and monopolar groups was 23.88 ± 4.92 and 24.64 ± 3.56 , respectively, which was found to be statistically insignificant in terms of difference ($P=0.202$). Similarly, there was no statistically significant difference between the two groups with regard to clinical history of abdominal surgeries, with the monopolar group showing a slightly higher prevalence of positive clinical history ($P=0.347$). The mean length of hospital stay for all patients was 1.62 ± 0.63 days, with the monopolar group being hospitalized for a slightly longer period (1.80 ± 0.69 vs. 1.45 ± 0.53).

Comparison of preoperative and postoperative hemoglobin levels between the two groups indicated a statistically significant difference between the postoperative hemoglobin levels, with the harmonic group showing substantially higher mean levels of hemoglobin (11.83 ± 1.26 g/dL) compared to the monopolar group (9.04 ± 1.13 g/dL) (Figure 1). Conversely, there was no statistically significant difference between the hemoglobin levels prior to surgery ($P>0.05$). These findings indicated that patients in the monopolar group were more vulnerable to perioperative hemorrhage.

As shown in Figure 2, the mean time to vaginal cuff separation for all patients was 25.47 ± 6.20 min, with the monopolar group requiring a significantly longer period of time (28.70 ± 5.93 min) for vaginal cuff separation compared to the harmonic group (22.24 ± 4.59 min), indicating the higher temporal efficacy of the harmonic method ($P<0.001$).

Postoperative adverse events including cuff-related hematoma, hematuria, uterine perforation, prerequisite for blood transfusion and trocar catheter-related hematoma were screened for all patients. Of the 210 patients involved, 80 (38%) did not experience any adverse events, with the harmonic group being significantly less likely to show adverse events compared to the monopolar group (50 vs 30, $P<0.05$). Vaginal laceration was the most prevalent adverse event occurring in 111 (52.85%) patients out of the 210 participants (Figure 3). Patients in the monopolar group were significantly more predisposed to vaginal laceration than participants in the harmonic group

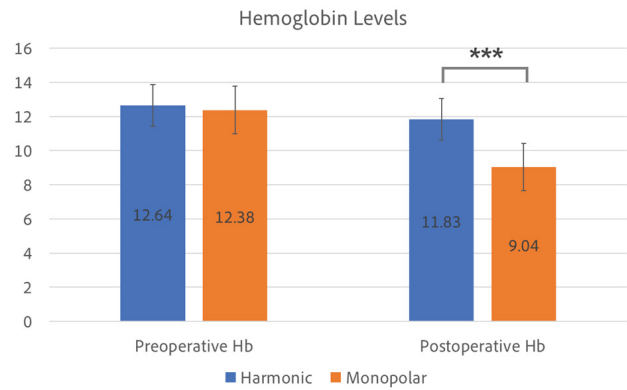


Figure 1: Comparison of preoperative and postoperative hemoglobin levels between the harmonic and monopolar groups (The *** symbol indicates $P < 0.001$).

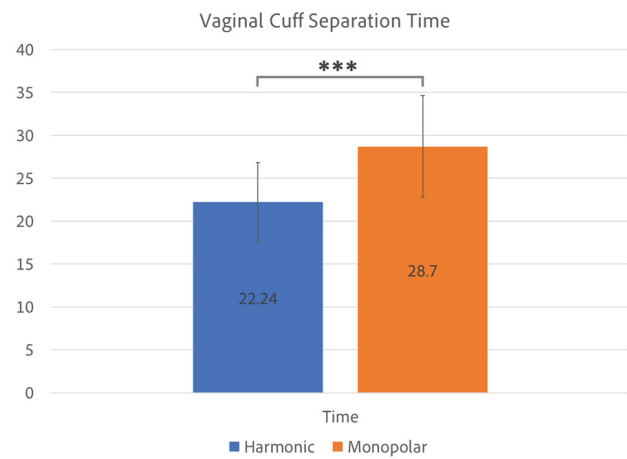


Figure 2: Comparison of vaginal cuff separation time between the harmonic and monopolar groups (The *** symbol indicates $P < 0.001$).

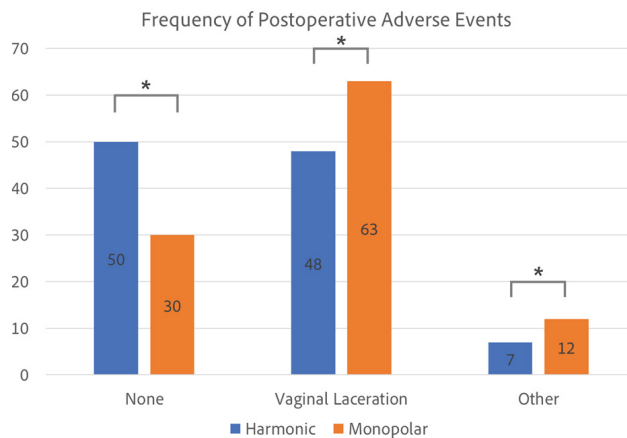


Figure 3: Comparison of the frequency of adverse events between the harmonic and monopolar group (The * symbol indicates $P < 0.05$).

(63 vs. 48, $P<0.05$). Similarly, the monopolar group also exhibited a higher prevalence of other types of adverse events compared to the harmonic group (12 vs. 7, $P<0.05$), indicating the superiority of harmonic technique in terms of patient safety.

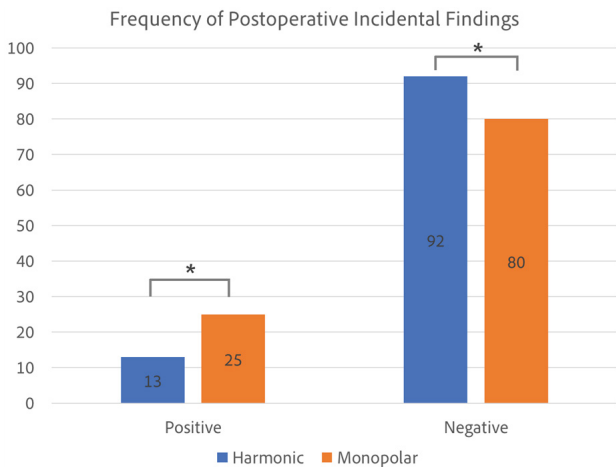


Figure 4: Comparison of postoperative incidental findings between the harmonic and monopolar groups (The * symbol indicates $P < 0.05$).

The frequency of postoperative incidental findings, including endometriosis, myoma, vanishing syndrome, umbilical hernia and major depressive disorder was significantly lower in the harmonic group compared to the monopolar group (13 vs 25, $P < 0.05$), suggesting that the harmonic technique might be superior in terms of postoperative complications and quality of life.

Discussion

The present study was designed with the aim of evaluating potential effects of laparoscopic hysterectomy using either monopolar or harmonic method on vaginal cuff separation, hemoglobin levels and postoperative adverse events and complications. In total, 210 women underwent laparoscopic hysterectomy with two harmonic ($n=105$) and monopolar ($n=105$) methods. The results of the study showed that the average age in the harmonic and monopolar groups was 24.76 years (± 5.41) and 25.75 years (± 4.64), respectively. The two harmonic and monopolar groups had no statistically significant difference in terms of age, BMI, history of previous abdominal surgery, average hemoglobin before surgery, and duration of hospital stay ($P > 0.05$), which indicated the comparability of the two groups. The mean hemoglobin level after surgery in the harmonic group (11.83 ± 1.26) was significantly higher than the monopolar group (9.04 ± 1.13) ($P < 0.001$). The average duration of vaginal cuff separation in the monopolar group (22.24 ± 4.59) was significantly less than the harmonic group (28.70 ± 5.93) ($P < 0.001$). The frequency of adverse events after surgery, especially vaginal laceration, was lower in the harmonic group (45.7%) than in the monopolar group (60%) ($P = 0.015$). The frequency of incidental findings or complications, especially endometriosis, was lower in the harmonic group (12.4%) than in the monopolar group (23.8%) ($P = 0.031$). Importantly, in this study, no cases of vaginal cuff dehiscence were observed in the two groups.

Our findings align with Gorginzadeh et al. (15), who

reported less thermal damage with harmonic devices in 2024, and Taşkın et al. (14), who found no significant differences in vaginal cuff dehiscence rates between different energy modes in 2019. Overall, while harmonic devices may offer advantages in reducing blood loss and complications, monopolar devices demonstrate efficiency in reducing operative time. In line with the results of our study, in a randomized trial study conducted by Holub et al. (16) with the aim of comparing intraoperative and postoperative parameters in two groups of women undergoing harmonic scalpel surgical techniques and electro-surgery in laparoscopic hysterectomy, women were randomly assigned to one of harmonic scalpel and electro-surgery groups were placed. The results showed that in the electro-surgery and laparoscopic hemostasis groups, the average time needed to tighten and incise the infundibulopelvic ligaments was 9.9 and 10.1 minutes, respectively, while the time needed to complete the entire operation was 90.6 and 82.9 minutes, which was not statistically significant. Furthermore, there was no significant difference between the groups in any of the variables during or after the operation. Ultimately, this study concluded that both types of harmonic scalpel surgery and electro-surgery seem feasible and effective in laparoscopic hysterectomy (16).

In 2010, a clinical trial conducted by Drahonovsky et al. (17) with the aim of investigating the results of laparoscopic hysterectomy with two harmonic and monopolar methods showed that although both harmonic and monopolar electro-surgery methods were effective in maintaining hemostasis and dissection surgery, in cases where the uterus was myomatous, monopolar technique was found to be superior compared to the harmonic method (17). In another study conducted by Sundaram et al. (18) with the aim of exploring the complications and consequences of total laparoscopic hysterectomy (TLH) with harmonic ultrasound on 420 candidates for this surgery, the results showed that the mean duration of surgery was 60 min and the mean blood loss was 40 ml. This study concluded that TLH with harmonic method significantly reduced operation time and blood loss, while conferring minimal lateral thermal expansion as an important advantage (18).

Table 1. Comparison of demographic data between the two groups of patients.

Variable	Population (n = 210)		P-value
	Harmonic (n = 105)	Monopolar (n = 105)	
Age (years)	24.74 \pm 5.41	25.75 \pm 4.64	0.111
BMI (kg/m ²)	23.88 \pm 4.92	24.64 \pm 3.56	0.202
Past Surgical History of Abdomen (n, %)	Positive	8 (7.6%)	0.347
	Negative	97 (92.4%)	
Length of Hospital Stay	1.45 \pm 0.53	1.80 \pm 0.69	0.387

Litta et al. (19), in 2010, conducted a clinical trial aimed at investigating the efficiency and safety of using harmonic scalpel and monopolar hook to reduce the volume of bleeding during myomectomy. To this end, 80 patients were randomly divided into two groups each with 40 participants. The first group underwent hemostasis with monopolar electrosurgery and epinephrine solution, and the second group underwent the same surgical intervention using the harmonic technique. The findings confirmed that the use of harmonic scalpel accelerated the surgical procedure and alleviated pain 24 hours after the operation compared to the monopolar electrosurgery group (19). Later that year, Gelmini et al. (20) evaluated the efficacy of harmonic scalpel in laparoscopic cholecystectomy of the gallbladder by conducting a trial, in which 95 patients underwent cholecystectomy with harmonic scalpel. The findings suggested that the harmonic scalpel was not only a safe and effective tool, but also a reliable alternative to monopolar hooks, since it provided complete hemobiliary stasis, while reducing the duration of surgery at a lower cost (20).

As confirmed by the present study, there is a significant difference in vaginal cuff separation time between the use of harmonic and monopolar surgical techniques, with the harmonic scalpel being associated with a relatively shorter procedure. This could be attributed to the structure of the harmonic scalpel, which is a multi-purpose instrument that replaces the four instruments of dissector, clip, scissors and electrosurgical hook/spatula that are normally used in conventional laparoscopic hysterectomy. As such, there is no need to change instruments frequently, hence, the time-saving effect. Additionally, no smoke is produced when using the harmonic scalpel, which further contributes to saving time, because the camera lens does not need to be cleaned frequently and provides a clearer field of action for the surgeon (21-24).

More recently, in 2018, Rajnish et al. (25) compared the operation time and postoperative complications between conventional laparoscopic cholecystectomy (CLC) and harmonic scalpel laparoscopic cholecystectomy (HLC), reporting significantly less average duration of surgery, postoperative pain and blood loss in patients undergoing HLC compared to conventional laparoscopy (25). In our study, the mean postoperative hemoglobin level in the harmonic group (11.83 ± 1.26) was significantly higher than the monopolar group (9.04 ± 1.13) ($P < 0.001$). Jain et al. (26) and Kandil et al. (27) observed a significant reduction in blood loss in the harmonic group, which was indirectly measured by the decrease in hemoglobin and hematocrit. As reported by Rajnish et al., application of the harmonic scalpel did not result in intraoperative bleeding or damage to the adjacent tissues was observed, and none of the patients had a decrease in hemoglobin (25). Overall, most studies have shown that the use of harmonic scalpel in laparoscopic hysterectomy is associated with fewer

complications and consequences after surgery and have recommended its use.

Limitations

The present study has several limitations. Firstly, its cross-sectional design and lack of random allocation of samples into the groups under investigation are significant drawbacks, as randomized clinical trials (RCTs) are more suitable for comparing the complications and outcomes of two surgical methods. Additionally, there is a possibility of information bias during data extraction from medical records, as well as selection bias due to the absence of random sample allocation and the single-center nature of the study. Furthermore, the costs associated with monopolar and harmonic methods could have influenced the choice of techniques in our study hospital.

Conclusions

The present study demonstrated that vaginal cuff separation using a harmonic scalpel in laparoscopic hysterectomy resulted in better outcomes compared to the monopolar hook method. Specifically, patients in the harmonic group demonstrated higher postoperative hemoglobin levels, fewer postoperative complications such as vaginal lacerations, and lower incidences of incidental findings like endometriosis. Additionally, although the average duration of the procedure was shorter with the monopolar method, the overall benefits associated with the harmonic scalpel suggest its superiority. Given these findings, the use of harmonic scalpels is recommended for vaginal cuff separation in laparoscopic hysterectomy to enhance patient outcomes and reduce the likelihood of complications. Further research, ideally through randomized clinical trials, is warranted to confirm these results and establish comprehensive guidelines for surgical practices.

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