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Total Laparoscopic Hysterectomy with Uterine Artery Clipping Vs. Conventional Laparoscopic Hysterectomy: A Randomized Controlled Trial

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ABSTRACT

Background & Objective: Total Laparoscopic Hysterectomy (TLH) is a widely used minimally invasive approach for hysterectomy. Preoperative uterine artery clipping has been proposed to reduce blood loss and surgical complications, but its clinical utility remains uncertain. The present study was conducted with aim to compare the conventional laparoscopic hysterectomy vs. Total Laparoscopic Hysterectomy (TLH) with preoperative uterine artery clipping.

Materials & Methods: This randomized controlled trial included 42 women undergoing TLH at Ain Shams University Maternity Hospital. Participants were randomly allocated to either the study group (Uterine artery clipping prior to TLH) or the control group (conventional TLH). The assessed outcomes included Estimated Blood Loss (EBL), operative time, hemoglobin changes, intraoperative complications, and hospital stay. Data was analyzed using SPSS software (version 23.0). P<0.05 was considered significant.

Results: There were no significant differences between the two groups in baseline characteristics. Mean EBL was lower in the study group (130.75±113.69 ml) compared to the control group (173.86±119.32 ml), but the difference was not statistically significant (P=0.238). The mean operative time was significantly longer in the study group (72.76±7.05 min) than in the control group (63.76±6.28 min) (P<0.001). No significant differences were found in hemoglobin levels postoperatively, intraoperative complications, or hospital stay.

Conclusion: A longer operating time was the consequence of TLH with preoperative uterine artery cutting, but there were no further advantages in terms of blood loss or other outcomes.

Keywords: Total laparoscopic hysterectomy, Uterine artery, Clipping, Ligation, blood loss

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1. Introduction

Total Laparoscopic Hysterectomy (TLH) is a widely adopted minimally invasive technique for the removal of the uterus, offering several advantages over open surgery, such as reduced postoperative pain, shorter hospital stay, quicker recovery, and improved cosmetic outcomes (1,2). Despite these benefits, intraoperative bleeding remains a key concern, particularly when addressing the uterine arteries during dissection (3).

Anatomically, the uterine artery divides into ascending and descending branches upon entering the uterus. Dissecting the vessel close to the uterus, as in conventional TLH, may leave the ascending branch unclotted, increasing the risk of bleeding (4). Furthermore, the close proximity of the uterine artery to the ureter poses a risk for inadvertent ureteral injury during dissection (5). To address these challenges, various techniques have been proposed for uterine artery ligation, including bipolar electrocautery, suturing, endovascular stapling, and the use of clips. One of these approaches involves clipping the uterine artery at its origin from the internal iliac artery prior to TLH. This may help reduce intraoperative blood loss by devascularizing the uterus before dissection (4,6).

However, there is limited evidence regarding the effectiveness of prior uterine artery clipping. Some studies reported a significant reduction in blood loss and operating time, while others find no added benefit (7,8). Thus, the present study was conducted with aim to compare the conventional laparoscopic hysterectomy vs. Total Laparoscopic Hysterectomy (TLH) with preoperative uterine artery clipping.

2. Materials and Methods

This randomized controlled trial study was conducted at Ain Shams University Maternity Hospital. The research comprised 42 women who were admitted to the general gynecology outpatient clinic and were scheduled to have TLH between January 2022 and December 2022. This study was authorized by the Ain Shams University Maternity Hospital's Institutional Review Board and the Faculty of Medicine's Research Ethics Committee in accordance with the WMA Declaration of Helsinki (FWA 000017585) (Approval Number MD64/2019). The trial was filed at ClinicalTrials.gov (ID: NCT05028543) before it began.

The patient outcomes were assessed, with particular emphasis on blood loss as the primary outcome, as well as secondary outcomes, including clip failure, severe bleeding, postoperative re-exploration, intraoperative complications, postoperative complications, and total operative time.

The sample sized was calculated using the PASS 11 program, a power of 99% and an alpha error of 5%, and a previous study by Kale et al., (7), which revealed total blood loss in conventional TLH versus TLH with prior uterine artery clipping at its origin (TLH+UAL) (109.38±33.03 versus 47.50±8.12, respectively). A sample size of at least 42 female patients who underwent hysterectomy (21 patients in each group) was adequately powered for this primary outcome.

In this study, patient randomization was conducted via a computer-generated randomization plan. The allocation concealment mechanism involved the use of consecutively numbered opaque sealed envelopes, with each envelope containing a letter corresponding to either group A (conventional TLH) or group B (laparoscopic clipping of the uterine artery before TLH). Participating women were assigned to a group on the basis of the letter inside the envelope. The randomization process was conducted blindly via the computer-generated plan, ensuring impartial allocation.

The enrolled patients were women who were indicated for hysterectomy due to fibroids exhibiting pain or bleeding, adenomyosis exhibiting pain or bleeding, postmenopausal hemorrhage, and endometrial hyperplasia exhibiting vaginal bleeding. In addition, uterine fibroids, polyps, and adenomyosis have been seen in uteri smaller than 16 weeks. However, based on prior history and inspection, we did not include women who undergone ureteric surgery that might have increased the risk of ureteric damage, undergone uterine artery embolization, or had suspected significant pelvic adhesions, known tube ovarian pathology necessitating initial laparotomy, such as big adnexal masses, conditions postponing the repair of the vaginal vault, such severe liver disorders, uncontrolled diabetes, or extended corticosteroid medication, BMI more than 35 kg/m^2, diseases that prevent laparoscopic surgery, such as severe cardiovascular illness, cervical myomas and wide ligaments that prevent access to the lateral pelvic wall, and uterine descent in the second or third degree.

After providing informed and written consent, the recruited patients were subjected to preoperative assessment, including detailed history collection, general and gynecological examinations, laboratory testing, and ultrasonography scanning. Finally, to exclude malignancy, endometrial biopsy, and cervical smear were performed, and 24 hours before the operation, 2 units of packed RBCs were prepared.

All the subjects were operated on by the same surgical team. They received intravenous antibiotics 30 minutes before the induction of anesthesia {Cefotaxime 1 gm (Claforan®-Sanofi-Cairo-Egypt) & metronidazole 500 mg (Flagyl®-Sanofi- Cairo-Egypt)}. We used the direct approach for primary port insertion to enter the abdomen. After thorough exploration of the pelvic cavity, the entire abdomen was surveyed before the procedure started. The size of the uterus, and the presence of myomas and adnexa were visualized. In Group A, women who underwent conventional TLH followed a specific sequence of actions. Initially, advanced bipolar diathermy LigaSurTM was used to coagulate the round and utero-ovarian ligaments. The broad ligament was opened to expose the uterine vessels, followed by the creation of a bladder flap to access the lower uterine segment. The posterior peritoneum at the lower uterine segment was opened, and the uterine vessels were coagulated via the LigaSur. These steps were then repeated on the other side. The uterine vasculature was separated and coagulated via advanced bipolar cautery, and the vaginal wall was cut over the V care cup. The uterus with its cervix was subsequently delivered through the vagina, and the vault was closed via a laparoscopic approach via the horizontal method via 0-vicryl sutures® with a 40 mm half-circle tapering-point needle and intracorporeal knots. sutured, and the incisions at the port sites were closed.

In Group B, where uterine artery occlusion was performed prior to TLH, the following procedure was carried out: The posterior and medial portions of the infundibulopelvic ligament served as the starting point for the medial approach used to dissect the uterine artery. The first step included identifying the ureter. The origin of the uterine artery can be found by grasping the destroyed umbilical artery at the anterior abdominal wall and pulling it back. The uterine artery passes almost parallel to the ureter and medially to the umbilical artery. This anatomical site was chosen to attack the uterine artery for clipping. To facilitate exposure at this specific anatomical site, both ovaries were temporarily suspended in the anterior abdominal wall via a transfixing Prolene 2-0 stitch® inserted through a straight needle, (Figure 2). This bilateral step was performed before proceeding with the remaining steps of the procedure, which followed the same

approach as conventional TLH. Using a clip applier, the uterine vessels were cut off from the hypogastric vessels at their origin. Two continuous 5 mm titanium metallic clips were used to cut the artery, and the same procedures as the traditional approach were followed for the laparoscopic hysterectomy (Figure 3). Once the procedure was completed, this temporary suspension was released, allowing both ovaries to return to their normal position at the ovarian fossa.

Postoperative assessment was done: Vital signs were assessed, and postoperative analgesia, antibiotics, and IV fluid were prescribed as the hospital protocol. Blood loss was estimated via the amount of intraoperative blood in the suction bottle, excluding the volume of saline wash as well as the decrease in postoperative hemoglobin and hematocrit 24 hours after the end of the procedure through the following formula:

$$V_L = \text{EBV} \times \frac{HCT_o - HCT_f}{HCT_{av}}$$

VL: volume lost; EBV: estimated blood volume (65 mL/kg for adult women); HCTo: initial hematocrit; HCTf: final hematocrit; HCTa:, average initial and final hematocrit **(10)**.

Finally, any postoperative complications, such as severe bleeding and bowel injury, or failed procedures, such as clip failure and conversion to laparotomy, were recorded.

Data were analyzed using SPSS software (Version 23.0). Whereas nonnormally distributed variables (nonparametric data) are displayed as medians with Interquartile Ranges (IQRs), quantitative data with parametric (normal) distributions are displayed as means±standard deviations and ranges. Qualitative variables are also shown as percentages and figures. P<0.05 was considered statistically significant.

3. Results

Initially, 81 participants were assessed for eligibility. Out of these, 28 were excluded for reasons including failure to meet inclusion criteria or refusal to participate (with 9 explicitly declining). Ultimately, 91 participants were randomized into two groups: 26 were allocated to the study group and 27 to the control group. During the follow-up phase, 5 participants were lost from the study group and 6 from the control group, indicating attrition. Despite these losses, both groups had an equal number of participants **(21)** analyzed in the final analysis (Figure 1).

The participants had a mean age of 47.69±4.02 years, and the mean BMI was 30.29±1.57 kg/m^2. Baseline characteristics, previous history, and medical conditions did not significantly differ between the study and control groups (Table 1).

In terms of operative time, a statistically significant difference was observed between the two groups (P<0.001). The mean operating time for the study group was 72.76±7.05 minutes and for the control group was 63.76±6.28 minutes (P<0.001) (Table 2). On the other hand, postoperative hemoglobin, postoperative hematocrit, and hematocrit decline did not significantly differ across the groups (Table 3). The mean Estimated Blood Loss (EBL) was 130.75±113.69 ml in the study group and in the control group was somewhat higher (173.86±119.32 ml), but this difference was not statistically significant (P=0.238) (Figure 4).

Table 1. Comparison between groups according to baseline characteristics

Baseline characteristics	Control Group (n=21)	Study Group (n=21)	Test value	P-value
Age (years)				
Mean±SD	47.29±3.68	48.10±4.39	0.420	0.521
Range	38-55	38-56		
BMI [wt/(ht)^2]				
Mean±SD	30.33±1.62	30.24±1.55	0.038	0.847
Range	29-34	28-35		
Obstetric History				
Mean±SD	2.67±1.53	2.48±0.87	0.246	0.623
Range	0-6	1-4		
Parity				
NG	2(9.5%)	0(0.0%)	x^2=4.800	^{FE}0.187
P1-2	8(38.1%)	12(57.1%)		
P3-4	9(42.9%)	9(42.9%)		
P5-6	2(9.5%)	0(0.0%)		
Medical History				
Anemia	0(0.0%)	1(4.8%)	x^2:1.008	^{FE}0.315
Controlled HTN	6(28.6%)	3(14.3%)	x^2:1.244	^{FE}0.265
Controlled DM	6(28.6%)	3(14.3%)	x^2:1.244	^{FE}0.265

The t-independent sample t test was used for the mean±SD; x^2: Chi-square test for number (%) or Fisher's exact test, when appropriate A P-value>0.05 is insignificant.

Blood loss and operating time were positively correlated in the control group (r= -0.456, P=0.038). Additionally, positive correlations were found between the operative time and the preoperative hemoglobin level and decrease in the hemoglobin level (r=0.524, P=0.015; r=0.540, P=0.012). In the study group, positive correlations were observed between operative time and preoperative hemoglobin (mg) and uterus weight (gm) (r=0.533, P=0.013; r=0.617, P=0.003). These findings indicate a relationship between blood loss, operative time, and specimen weight, with heavier samples associated with increased blood loss and longer operative times. The statistically significant correlations were found between operative time and preoperative hemoglobin and uterus weight (Table 3).

Intraoperative complications did not significantly differ between the two groups (P>0.05) (Figure 5), and the mean length of hospital stay was similar between the control and the study groups (P=1.000).

Table 2. Comparison between groups according to operative time and pre and postoperative hemoglobin

	Control Group (n=21)	Study Group (n=21)	Test value	P-value
Operative time (min)				
Mean±SD	63.76±6.28	72.76±7.05	19.074	<0.001**
Range	55-80	60-90		
Preoperative hgb 1 (mg)				
Mean±SD	10.15±0.41	10.15±0.64	0.001	0.977
Range	9.5-10.8	8-11		
Drop of Hgb (mg)				
Mean±SD	0.41±0.32	0.32±0.25	1.039	0.314
Range	0-1	0-1		
Postoperative hgb (mg)				
Mean±SD	9.81±0.28	9.95±0.44	1.462	0.234
Range	9-10.2	9.3-10.8		

The t-independent sample t test was used for the mean±SD; A P-value>0.05 is insignificant

Table 3. Correlations between blood loss (in ml) or operative time and all different parameters, according to the Pearson correlation coefficient in the study group, and the control group

Control group	Blood loss (ml)		Operative time (min)	
	r-value	P-value	r-value	P-value
Blood loss (ml)			-0.456	0.038*
Age (years)	-0.165	0.475	0.382	0.088
BMI [wt/(ht)^2]	0.342	0.129	-0.193	0.402
Parity	0.073	0.754	-0.285	0.211
Operative time (min)	-0.456	0.038*		
Preoperative hgb (mg)	-0.105	0.650	0.524	0.015*
Post-operative hgb (mg)	-0.128	0.580	0.247	0.281
Drop of Hgb (mg)	-0.233	0.310	0.540	0.012*
Uterus weight (gm)	0.074	0.749	0.127	0.583
Hospital stay (days)	-0.124	0.593	0.045	0.846
Study group				
Blood loss (ml)			0.185	0.422
Age (years)	-0.039	0.868	-0.211	0.359
BMI [wt/(ht)^2]	-0.004	0.985	-0.178	0.440
Parity	-0.078	0.738	0.239	0.297
Operative time (min)	0.185	0.422		
Preoperative hgb (mg)	0.030	0.897	0.533	0.013*
Postoperative hgb (mg)	-0.099	0.669	0.428	0.053
Drop of Hgb (mg)	-0.123	0.595	-0.335	0.138
Uterus weight (gm)	0.350	0.120	0.617	0.003*
Hospital stay (days)	-0.166	0.472	-0.415	0.062

r-Pearson Correlation Coefficient, P-value>0.05 is insignificant; *P-value<0.05 is significant; **P-value<0.001 is highly significant

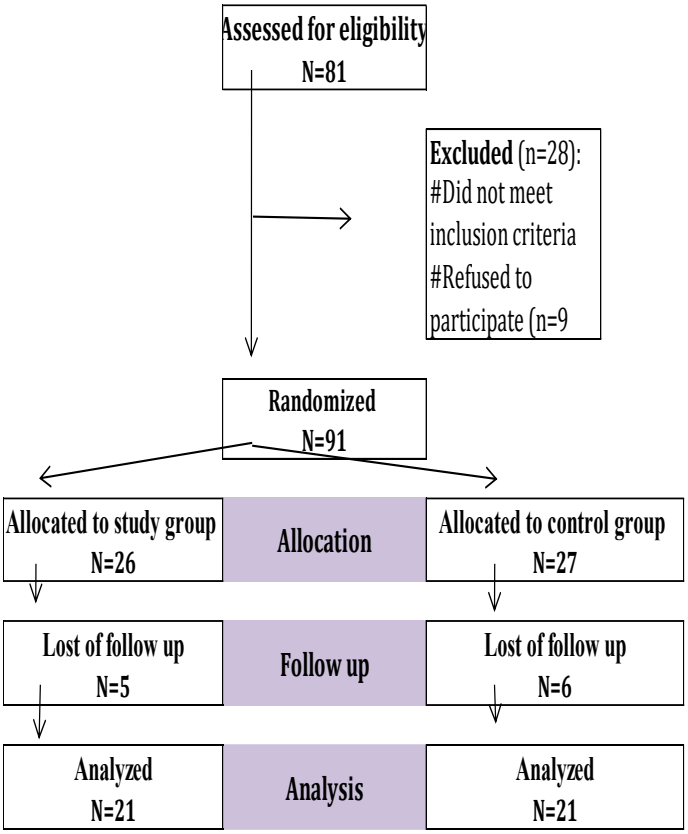
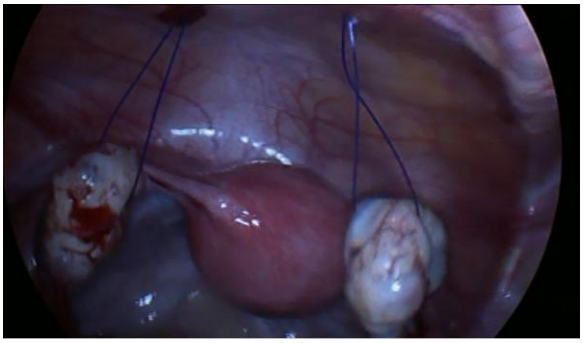


Figure 1. **Consort Flow chart of the studied cases**



(A)



(B)

Figure 2. **A&B Both ovaries were temporarily suspended to the anterior abdominal wall using atrnsfixing prolene 2-0 stitch ®**

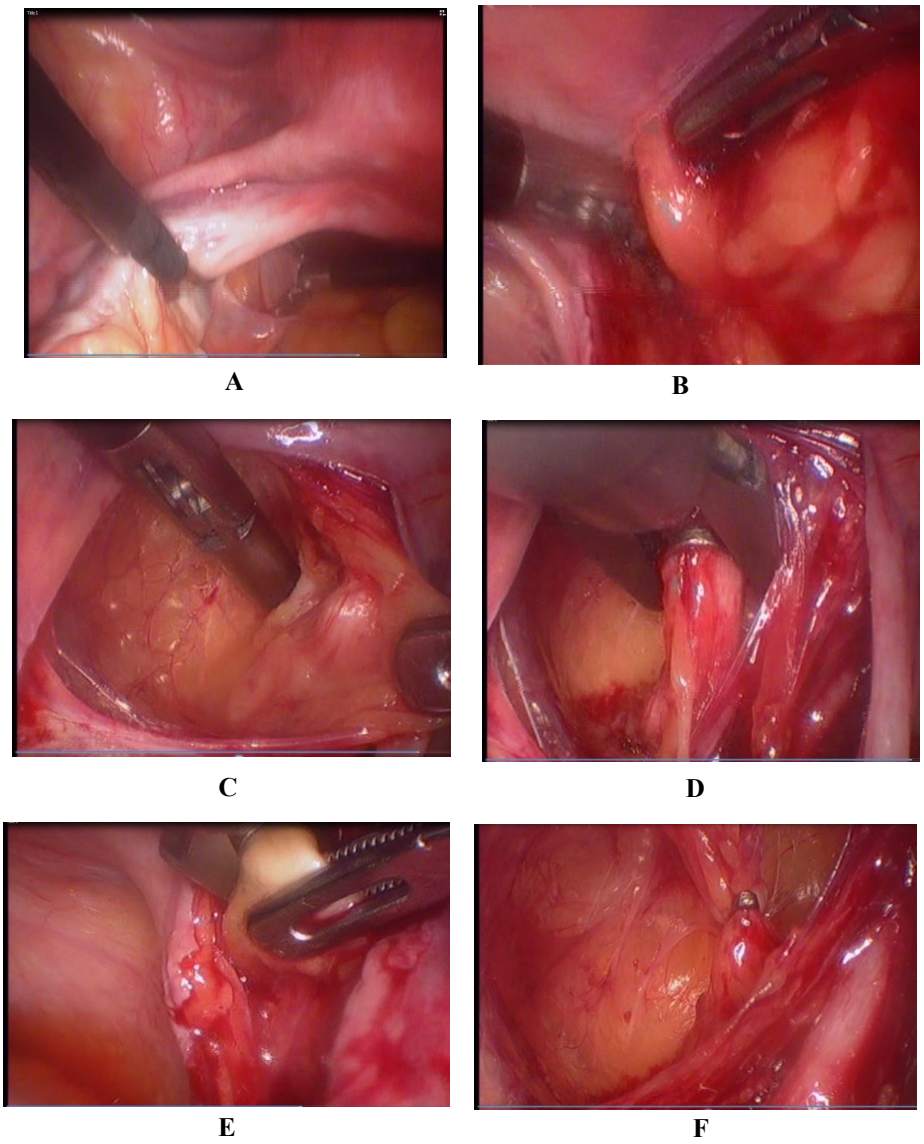


Figure 3. **A) The peritoneum of the ovarian fossa (B,C) Dissection uterine artery. (D) Placement of vascular clip using clips applicator over the uterine artery. (E&F) metallic clipping of uterine artery at its origin in our study included patient.**

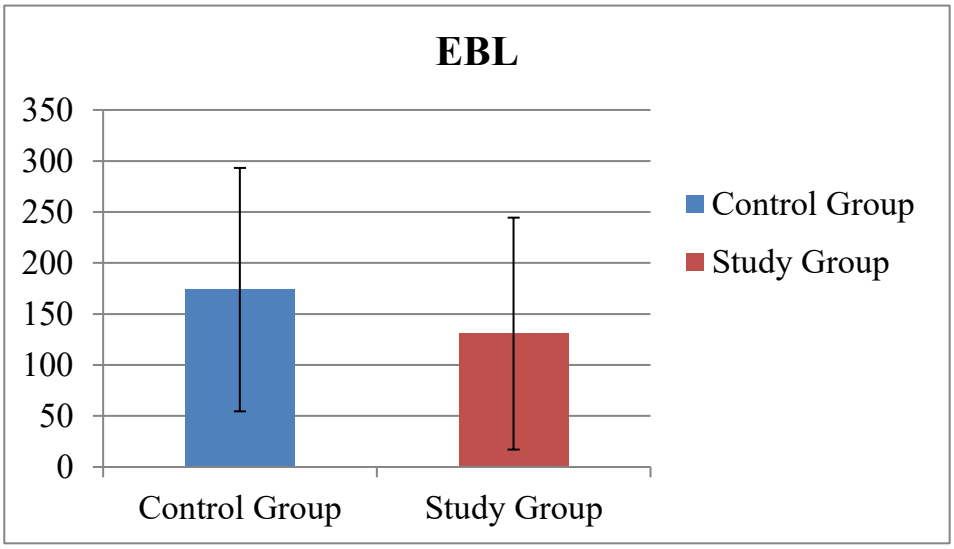


Figure 4. **Comparison between groups according to EBL.**

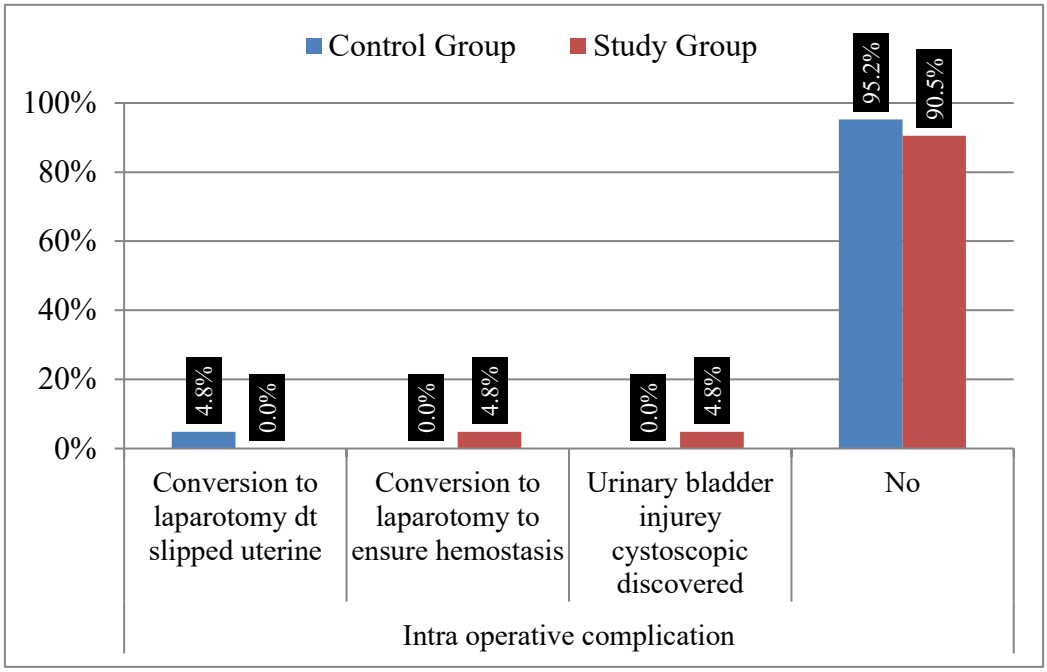


Figure 5. Comparison between groups according to intra operative complication

4. Discussion

The occlusion of uterine arteries prior to TLH is a technique that involves blocking the blood supply to the uterus by placing clips or sutures on the uterine arteries, which are the main blood vessels supplying the uterus. Devascularization has been shown to decrease blood loss during surgery, enhance surgical field visibility, and potentially reduce the risk of complications. Theoretically, it should be beneficial in cases involving a large uterus, fibroids, or a history of heavy menstrual bleeding **(11)**.

In our study, the first group underwent TLH with uterine artery clipping, and the second group underwent conventional TLH. The analysis of blood loss revealed no significant difference between the two groups. The mean blood loss in the first group was 132.14±22.50 ml compared with 173.86±119.32 ml in the second group, with an insignificant difference. A similar finding was reported by Abo-Hashem et al., **(9)**, who reported no significant difference in blood loss between the two groups comparing TLH with uterine clipping at its origin and conventional TLH. The mean blood loss in their study was 97.67±34.31 ml in the TLH with uterine clipping group and 104.33±39.19 ml in the conventional TLH group.

A study by Pan et al., **(12)** also supported our findings, as they reported no significant difference in blood loss between TLH (177.2±80 ml) and TLH with coagulation of the uterine artery at its origin (154.9±30.2 ml).

In contrast to our study, Poojari et al., **(6)** reported that the conventional TLH group presented a mean blood loss of 70 ml, whereas the TLH group with prior uterine artery ligation presented a mean blood loss of 43 ml. Moreover, Sinha et al., **(13)** reported contrasting outcomes in their study, where the TLH with early uterine ligation group experienced a mean blood loss of 50 ml compared with 60 ml in the classical TLH group. Notably, Kale et al., **(7)** reported significant differences in their study, with TLH resulting in a mean blood loss of 109.38±33.03 ml, whereas TLH with uterine artery ligation at the beginning of surgery resulted in a mean blood loss of 47.50±8.12 ml. These discrepancies may be attributed to variations in the technique employed for securing the uterine artery, as the aforementioned studies utilized uterine artery ligation instead of clipping. Additionally, the population characteristics, as well as, the uterine pathologies, were different in these studies.

Peng et al., **(14)** presented contrasting findings regarding uterine artery occlusion during laparoscopic myomectomy (LUAO). They reported that the amount of blood loss in the LUAO+LM group was significantly lower than that in the nonocclusion group (177.97±104.09 mL vs. 258.10±119.55 mL). This significant impact of LUAO+LM may be explained by different blood supply patterns of uterine fibroids, where the blood is solely dependent on the uterine artery. However, the situation differs in cases of hysterectomy, where the uterus receives its blood supply from an extensive anastomosing net work of blood vessels, which includes not only the uteine artery but also the vaginal, cervical and ovarian branches, which might explain why uteine artery occlusion in the TLH is not as effective as it is in laparoscopic myomectomy.

In the present study, the study and control groups' operational times differed significantly. The study

group's mean operating time (72.76±7.05 minutes) was significantly longer than that in the control group (63.76±6.28 minutes). A number of factors contributed to the research group's prolonged operating duration. First, it takes longer to position the clips. Furthermore, it takes a lot of time to suspend the ovaries and expose the uterine artery at its origin, which separates it from the ureter. Abo-Hashem et al., **(9)** conducted a similar study and reported that TLH with prior uterine artery clipping had a mean operative duration of 48.93±8.3 minutes, whereas conventional TLH had a mean operative duration of 58.83±9.26 minutes, which was significantly different from our study results.

Our findings, however, differ from those of the study by Poojari et al., **(6)**, where the TLH group had a mean surgery duration of 71 minutes, whereas the TLH with earlier uterine artery ligation group had a mean surgery duration of 60 minutes, indicating a statistically significant difference between the two groups. Similarly, Kale et al., **(7)** reported significant differences in their study, with TLH resulting in a mean surgery duration of 99.16±7.01 minutes, whereas TLH with uterine artery ligation at the beginning of surgery resulted in a mean surgery duration of 63.16±7.16 minutes. The findings of the above studies that showed prior uterine artery ligation was less time consuming may be attributed to differences in the occlusion technique used (coagulation or ligation, rather than clipping).

In the present study, a few intraoperative complications were observed in both groups. In the study group, one patient experienced intraoperative urinary bladder injury, which was diagnosed via a cystoscope and repaired laparoscopically during the same surgical session. Additionally, one patient in the study group required conversion to laparotomy to achieve proper hemostasis. In the control group, one patient had to be converted to laparotomy due to bleeding caused by slipping of the uterine artery. Sinha et al., **(13)** reported one patient in the classical TLH group suffering from secondary hemorrhage and vault sutures, and in the same group, two patients experienced blood loss requiring 4-unit blood transfusions.

This study had several strengths. First, it has a well-designed protocol with proper randomization and a concealed allocation process. Additionally, the study had sufficient statistical power to detect the primary outcome of operative blood loss. Additionally, the UA occlusion technique involves the use of a noncost, readily- available, reusable metal clip, which is widely used in laparoscopic cholecystectomy and appendectomy. In contrast, some other studies utilized more expensive, disposable clipping devices.

There were several limitations to this study. First, only one technique of uterine artery occlusion, specifically uterine artery clipping at its origin via a metallic clip, was implemented. Other occlusion techniques, such as clipping via hemostatic clips or temporary ligation, were not investigated. Additionally, alternative approaches to uterine artery occlusion, such as the lateral or anterior approach, were not examined in this study. Finally, the study was not adequately powered to detect rare complications, including adverse effects.

5. Conclusion

According to the results of the present study, uterine artery clipping before Total Laparoscopic Hysterectomy (TLH) did not significantly reduce intraoperative blood loss compared to conventional TLH. However, the intervention was associated with a statistically significant increase in operative time. Both procedures demonstrated comparable safety profiles, with no major differences in intraoperative complications or postoperative outcomes. These findings suggest that although uterine artery clipping may theoretically offer hemostatic benefits, its routine use in TLH may not provide substantial clinical advantage. Its use may be reserved for selected cases where excessive vascularity or a large uterus is anticipated, and better control of intraoperative bleeding is desired. Surgeons should be adequately trained in pelvic anatomy to perform this technique safely, considering the proximity of critical structures like the ureter.

6. Declarations

Acknowledgments

The authors would like to express their gratitude to the Ain Shams University Maternity Laparoscopy unit staff and the patients who generously participated in our research.

Ethical Considerations

This study was conducted following the principles outlined in the Declaration of Helsinki and its subsequent revisions. Ethical approval was obtained from the Research Ethics Committee of the Faculty of Medicine, Ain Shams University (Approval Number: MD64/2022). The study protocol was registered at ClinicalTrials.gov under the identifier NCT05028543 before participant enrollment.

All participants provided written informed consent after receiving a comprehensive explanation of the study's objectives, procedures, potential risks, and benefits. Participation was entirely voluntary, and subjects were informed of their right to withdraw from the study at any point without any negative consequences.

Patient confidentiality and anonymity were rigorously maintained throughout the research process. Data collected were used exclusively for research purposes and stored securely to prevent unauthorized access.

Authors' Contributions

Protocol design: Professor Sabry Elsayed Hassan & Assistant Professor Mohamed Hamed Abdelaziz Salma. Data collection and analysis: Yasmeen Ahmed Mohamed Taha, Rania Gamal Anwar Elskaan. Manuscript writing: Yasmeen Ahmed Mohamed Taha, Rania Gamal Anwar Elskaan, Mohamed Hamed Abdelaziz Salama. Revision and approval: All authors read and approved the final version of the manuscript.

Conflict of Interest

The authors declare no competing interests

Research data

The research protocol used in this research was approved by the local institutional review board.

Data availability statement

Data can be shared if needed.

Fund or Financial Support

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