EARLY VERSUS ROUTINE UTERINE ARTERY OCCLUSION DURING TOTAL LAPAROSCOPIC HYSTERECTOMY

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ABSTRACT

Background: Hysterectomy is one of the most common gynecological surgical procedures performed worldwide. Vaginal, Laparoscopic and Open hysterectomy are the main routes for performing the procedure respectively. Although laparoscopic approach is the second preferred route, laparoscopy is indicated when vaginal access is obstructed by narrow pubic arch, nulliparous pelvis, large uterine size, or difficult uterine mobilization due to adhesions. During total laparoscopic hysterectomy (TLH), it is necessary for the uterine arteries (UAs) to be effectively closed. **Aim of the study:** To compare between early and conventional uterine artery occlusion as regard operative time, blood loss and possible complications during the performance of total laparoscopic hysterectomy. **Methods:** This randomized prospective study included 55 women with different uterine diseases admitted to Mansoura University Hospitals for TLH from November 2019 to December 2022 including 28 female patients underwent TLH with early uterine artery ligation (group A) compared to 27 female patients underwent TLH with the conventional technique (group B). **Results:** Group A (early UA ligation) had a significantly shorter operative time (46.07 ± 6.83 vs 0.26 ± 11.38 minutes; **P < 0.001**) and less blood loss (66.57 ± 5.04 vs 91.44 ± 15.98 ml; **P < 0.001**) when compared to group B (conventional TLH). There was no statistically significant difference regarding early postoperative complications.**Conclusions:** Early uterine artery ligation at its origin reduces intraoperative bleeding and shortens the procedure. Larger controlled and multicentric studies are needed to support our findings.

Key words: Hysterectomy, Laparoscopic, Uterine artery, Ligation.

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INTRODUCTION

Hysterectomy is a common gynecological procedure worldwide for benign uterine disease. Traditionally, this has been via the abdominal or vaginal routes **[1]**. Although, Laparoscopic approach is the second preferred route, laparoscopy is indicated when vaginal access is obstructed by narrow pubic arch, nulliparous pelvis, large uterine size, or difficult uterine mobilization due to adhesions. **[2]**.

Excessive intraoperative bleeding during total laparoscopic hysterectomy (TLH) is still an issue. The transfusion rate among hysterectomies for benign pathology is almost 3% **[3,4]**, with a higher risk of intraoperative blood loss in large uteri **[5]**. Nevertheless, despite the strong interest in reducing intraoperative bleeding, limited evidence is available regarding the technical aspects concerning uterine arteries (UA) management during a total laparoscopic hysterectomy (TLH) **[6]**.

An efficient closure of uterine arteries (UAs) is crucial during a TLH. The two main options consist of closing UAs at the origin from the internal iliac artery or at the uterus level (UL). This latter approach is the most used for a TLH, commonly considered easier because it avoids opening the retroperitoneum. Nevertheless, this choice is based exclusively on the surgeon's opinion and preference **[7]**.

There is shortage in the data that compared the two techniques, therefore the current study was conducted to compare operative time, estimated blood loss and postoperative complications during performing conventional laparoscopic hysterectomy versus early uterine artery occlusion at its origin.

Subjects and methods

This is a prospective randomized clinical study that was conducted on cases candidates for total hysterectomy at obstetrics and gynaecology department, Mansoura University Hospitals, Mansoura, Egypt. Patients were interviewed at Mansoura outpatient clinics and written informed consents were obtained. The study was approved from Mansoura Faculty of Medicine Institutional Research Board (Code No. MD/19.05.182).

This study included patients at any age group presenting with uterine disease who were candidates for total hysterectomy with good general condition of the patient (American Society of Anesthesiologists "ASA" score 1,2,3).

The cases with the following conditions were excluded; patients with ASA score 4 or more, patients with contraindication for laparoscopic surgery (e.g., severely compromised cardiopulmonary status, advanced liver disease, advanced kidney disease), uterine size > 16 weeks and patients with malignant uterine disease (>stage 1a G1) or associated suspicious adnexal mass (> 5cm).

Patients who met inclusion and exclusion criteria were randomly allocated to one of two groups, group A (Included cases where uterine artery was occluded before start of the procedure) and group B (included cases where uterine artery was sealed and cut after cutting the cornual pedicles).

The surgical team followed the standard procedure of laparoscopic hysterectomy. The prophylactic antibiotic, ceftriaxone 1gm was given 1 hour before surgery. For whom with history of allergy to cephalosporin, Clindamycin 600 was given. All equipment were checked and examined by the operator before induction of anesthesia.

Surgical technique:

Positioning: Dorsal lithotomy position with both arms tucked at sides then, Trendelenburg position following sterilization of abdomen and vagina and insertion of abdominal trocars.

Uterine manipulation: Foley's catheter was fixed then bimanual examination was performed to determine size and position of the uterus. Tenaculum was used to hold the anterior cervical lip then uterus was sounded to assess the length and direction of uterine cavity. RUMI® Uterine Manipulator (Cooper-Surgical, Trumbull, CT) was used.

Trocar insertion: Veress needle was inserted through the umbilicus and aspiration test was used for ensuring safe pneumoperitoneum. Abdomen was insufflated to 15 mm Hg. Three trocars were inserted as follows,

10 mm port at the umbilicus for laparoscopic camera

Palmer's point (2 cm below left subcostal margin in midclavicular line) was used for entry in patients with previous abdominal surgery or suspected adhesions.

5 mm port at the level of the umbilicus on left side at midclavicular line under vision.

5 mm port at the level of the umbilicus on right side at midclavicular line under vision.

Exposure of the operative field: Fine adhesions in Douglas Pouch or to lateral pelvic wall were released.

In case of early uterine artery ligation: Patients assigned to the closure of uterine vessels at its origin from the internal iliac artery undergo laparoscopic hysterectomy with uterine devascularization at the beginning of the procedure. Access to the retroperitoneum was done laterally to the infundibulo-pelvic ligament. The ureter was visualized and followed along its course. After dissection of pararectal and paravesical spaces, the uterine artery and its origin were freely dissected. The vessel was coagulated and cut just medially to its origin from the internal iliac artery using ligature vessel sealer.

Division of the round ligament: The round ligament of about 3 cm medial to its pelvic attachment was coagulated and cut (more lateral in cases with endometrial carcinoma) using Ligature vessel sealer. After dividing the anterior leaflet, a hole is made in the posterior one to facilitate exposure of pedicle of the infudibulo-pelvic ligament.

Division of utero-ovarian ligament and tubes (preserving the ovaries) or infudibulo-pelvic ligament (in case of unilateral or bilateral adnexectomy): Uterine manipulator was pushed upward and contralateral side to facilitate visualization. Ligature vessel sealer was used to coagulate and divide the infudibulo-pelvic ligament close to the ovary *(Hug the ovary)* and the tube and tubo-ovarian ligament in case of preserving the ovary.

Dissection of the broad ligament: Anterior and posterior leaflets of broad ligaments were coagulated and dissected on both sides from round ligament up to vesico-uterine peritoneal reflection.

Bladder dissection and mobilization: After pushing the uterus upward and backward using uterine manipulator, the peritoneum of bladder was grasped, dissected, and coagulated under cranial traction from lateral to medial to create a clear vesicovaginal plane. In case of previous cesarean section, sharp dissection was done very close to the cervix to avoid bladder injury.

Coagulation and cutting of the uterine vessels and cervical ligaments: Using ligature vessel sealer, bilateral uterine artery coagulation and dissection was done first. Both Mackenrodt's and uterosacral ligaments are then coagulated and sectioned bilaterally.

Colpotomy: Using monopolar hook, uterus was separated from vaginal vault starting from center anteriorly extending laterally and then posteriorly.

Removal of the uterus and vault closure: The uterus was removed vaginally followed by vaginal closure of the vault in continuous single layer using vicryl (1) suture.

Ensuring haemostasis: all pedicles were clearly visualized, and adequate haemostasis is ensured before removal of abdominal ports under vision.

Port closure: All ports were closed using polypropylene (2/0) suture.

The intraoperative data were recoded including operative time, amount of blood loss, additional operative procedures, intraoperative complications, and conversion rate. Postoperative Hb level and Hb deficit was Measured 24 hours after surgery. Hospital stay in days and postoperative pain score using Visual Analogue Scale (VAS) were recorded. Early postoperative complications defined as any unfavourable event occurring after surgery as paralytic ileus, wound infection, and vault hematoma were also reported.

Statistical analysis of data

The data collected were coded, processed, and analyzed with SPSS version 26 for Windows® (Statistical Package for Social Sciences) (IBM, SPSS Inc, Chicago, IL, USA). Qualitative data as number (frequency) and percent was presented. The Chi-Square test (Fisher's exact test or Monte-Carlo test) made the comparison between groups. The Kolmogorov-Smirnov test tested quantitative data for normality. To compare two groups with normally distributed quantitative variables, independent samples (student's) t-test was used and Mann-Whitney U-test was used if the data were abnormally distributed .For all tests, P values <0.05 are considered significant.

RESULTS

As shown in The Flow Chart (Fig. 1), 77 women were assessed for eligibility to participate in the study; 17 of them were excluded [not meeting inclusion criteria (n=10), declined to participate (n=7). The remaining 60 women were allocated to 2 groups, Group A included 30 women who underwent early uterine artery occlusion while group B included 30 women who underwent the conventional technique. 2 women in group A discontinued intervention "One developed severe bradycardia after induction of anesthesia and the other for Technical error" while 3 women in group B discontinued intervention "One for severe dense adhesions, and two for Technical error". Therefore, data of 28 women in group A and 27 women in group B were subjected to final analysis.

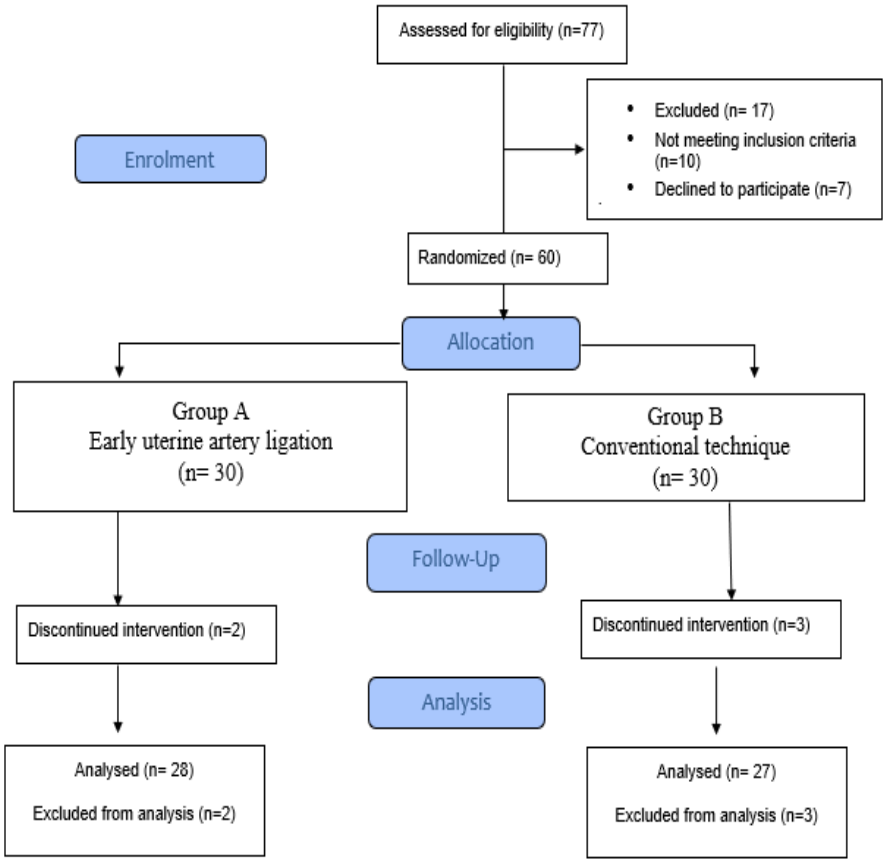

Figure (1): Flow Chart Showing Allocation of patients to studied groups

Table (1): Sociodemographic and obstetric data of both groups

Items		**Group A (n= 28)**	**Group B (n= 27)**	P value
Age (Years)		**48.43 ± 5.69**	**47.11 ± 4.41**	0.343
BMI (Kg/m^2)		**35.04 ± 3.17**	**33.56 ± 2.97**	0.080
Parities		**3 (1-5)**	**3 (0-5)**	0.879
Previous CS		**1 (3.6%)**	**5 (18.5%)**	0.075
Menopausal State	**Postmenopausal**	**14 (50%)**	**23 (85.2%)**	0.005*
	Pre and peri-menopausal	**14 (50%)**	**4 (14.8%)**	

Table 1 shows that there was no statistically significant difference between both groups as regard age, parity, previous CS and BMI. While there was statistically significant difference between the two groups as regard postmenopausal state being higher in group B (n=23) than group A (n=14).

Table (2): Medical and surgical data of both groups

Items		**Group A (n= 28)**	**Group B (n= 27)**	P value
Medical history	**Diabetes Mellitus**	**4 (14.3%)**	**2 (7.4%)**	0.236
	Hypertension	**3 (10.7%)**	**5 (18.5%)**	0.212
	Cardiac (Mild MR)	**2 (7.1%)**	**0 (0%)**	0.250
	Bronchial Asthma	**0 (0%)**	**5 (18.5%)**	**0.039***
	Hypothyroid	**1 (3.6%)**	**0 (0%)**	0.304
Previous pelvic surgery		**0 (0%)**	**1 (3.7%) (Left cystectomy)**	0.304
Uterine disorders (Pathology)	**Adenomyosis**	**6 (21.4%)**	**9 (33.3%)**	0.378
	Fibroid	**12 (42.9%)**	**9 (33.3%)**	
	Endometrial Hyperplasia	**6 (21.4%)**	**4 (14.8%)**	
	Atypical Endometrial Hyperplasia	**1 (3.6%)**	**4 (14.8%)**	
	Endometrial Carcinoma	**3 (10.7%)**	**1 (3.7%)**	

Table (2) shows that the Main indications of doing Hysterectomy were adenomyosis and uterine fibroids for both groups and there was no statistically significant difference between both groups as regard uterine pathology and patient medical history.

Table (3): Analysis of the operative data in both groups

Items	**Group A (n= 28)**	**Group B (n= 27)**	P value
Operative time (minutes)	**46.07 ± 6.83**	**60.26 ± 11.38**	< 0.001*
Estimated intraoperative blood loss (ml)	**66.57 ± 5.04**	**91.44 ± 15.98**	< 0.001*
Adhesiolysis	**5 (17.9%)**	**6 (22.2%)**	0.686
Salpingo-oophrectomy	**26 (92.2%)**	**24 (88.9%)**	0.609

Table (3) shows that there was statistically significant difference as regard operative time being longer in group B (± 60 minutes) than group A (± 46 minutes) ($p < 0.001$) and estimated intraoperative blood loss being higher in group B (± 91 ml) than group A (± 66 ml) ($p < 0.001$).

Table (4): Analysis of follow up postoperative data of both groups

Items	**Group A (n= 28)**	**Group B (n= 27)**	P value
Preoperative hemoglobin (gm/dl)	**11.34 ± 1.40**	**11.40 ± 1.08**	0.867
Postoperative hemoglobin (gm/dl)	**10.97 ± 1.08**	**11.11 ± .98**	0.618
Hemoglobin deficit (Percent of change) (%)	**0.2 (0-2.6)**	**0.2 (0-1.2)**	0.905
Pain score	**2 (1-4)**	**2 (1-3)**	0.357
Hospital stay (Days)	**3 (2-5)**	**3 (2-4)**	0.631

Table (4) shows that there was no statistically significant difference as regard Hb deficit, pain score, hospital stay between both groups.

Table (5): Intra and postoperative complications for both groups

Items	**Group A (n= 28)**	**Group B (n= 27)**	P value
Intraoperative bleeding	**1 (3.6%)**	**3 (11.1%)**	0.282
Visceral injury	**0 (0%)**	**1 (3.7%)**	0.304
Paralytic ileus	**1 (3.6%)**	**2 (7.4%)**	0.531
Wound infection	**1 (3.6%)**	**0 (0%)**	0.322
Vault hematoma	**1 (3.6%)**	**2 (7.4%)**	0.531
Overall complications	**3 (10.7%)**	**7 (25.9%)**	0.144

Table (5) shows that overall operative and postoperative complications were higher in group B (7 cases) than group A (3 cases). However, there was no statistically significant difference between the two studied groups.

DISCUSSION

Hysterectomy is one of the most common gynecological surgical procedures performed worldwide. Vaginal, Laparoscopic and Open hysterectomy are the main routes for performing the procedure respectively. Although, Laparoscopic approach is the second preferred route, laparoscopy is indicated when vaginal access is obstructed by narrow pubic arch, nulliparous pelvis, large uterine size, or difficult uterine mobilization due to adhesions. There are many types of laparoscopic hysterectomy, including: Total laparoscopic hysterectomy (TLH), Laparoscopic subtotal hysterectomy (LSH) and Laparoscopic-assisted vaginal hysterectomy (LAVH). TLH is the most common performed type.

Excessive intraoperative bleeding during TLH is still an issue. The transfusion rate among hysterectomies for benign pathology is almost 3% with a higher risk of intraoperative blood loss in large uteri. Nevertheless, despite the strong interest in reducing intraoperative bleeding, limited evidence is available regarding the technical aspects concerning UA management during a TLH.

An efficient closure of uterine arteries (UAs) is crucial during a total laparoscopic hysterectomy (TLH). The two main options consist of closing UAs at the origin from the internal iliac artery or at the uterus level (UL). This latter approach is the most used for a TLH, commonly considered easier because it avoids opening the retroperitoneum. Therefore, this choice is based exclusively on the surgeon's opinion and preference.

There is shortage in the data that compared the two techniques, therefore our study was conducted to compare operative time, estimated blood loss and postoperative complications during performing conventional laparoscopic hysterectomy versus early uterine artery occlusion at its origin.

It was a prospective randomized controlled study performed at Mansoura university hospitals from November 2019 to December 2022 including 28 female patients underwent TLH with early uterine artery ligation (group A) in addition to 27 female patients underwent TLH with the conventional technique (group B).

The current study was conducted to compare between early and conventional uterine artery occlusion as regard operative time, blood loss and possible complications during the performance of total laparoscopic hysterectomy.

The current study included 28 female patients underwent TLH with early uterine artery ligation (group A) in addition to 27 female patients underwent TLH with the conventional technique (group B). The main outcomes of our study were amount of blood loss, operative time.

There was no statistically significant difference between both groups regarding the sociodemographic data including age, BMI, medical and obstetric history.

In the current study, the mean duration of surgery in the internal artery occlusion group was 46.07 ± 6.83 minutes that was statistically significantly shorter as compared to the conventional group (60.26 ± 11.38 minutes) ($P < 0.001$).

This came in accordance with Poojari *et al*. (2014), Abo-Hashem *et al*. (2021), Sinha *et al.* (2008) and Kale *et al.* (2015) who showed that there was a significant difference between both groups being shorter in prior uterine artery occlusion at its origin group (60, 48.93 ± 8.3, 60, 63.16±7.16 minutes respectively) , than the conventional TLH group(71, 58.83 ± 9.26, 70, 99.16±7.01 minutes respectively) **[8,9,10,11]**.

On other hand our study results differ from Pan *et al.*, which was a study of TLH versus TLH with coagulation of uterine artery at its origin. TLH mean time of surgery was 95 minutes and TLH with coagulation uterine artery at its origin mean time of surgery was 97 minutes with no significant difference between both groups **[12]**.

As regard intraoperative blood loss, the mean amount of blood loss in the internal artery ligation group was 66.57 ± 5.04 ml that was statistically significantly lower as compared to the conventional group (91.44 ± 15.98 minutes) ($P < 0.001$).

This came in accordance with Uccella *et al* (2021), Poojari et al. (2014), Sinha *et al.* (2008) and Kale *et al.* (2015) who showed that the intraoperative blood loss was lower in the group assigned to closure at the origin (69.3, 43, 50, 47.50±8.12 mL respectively) (108.5 mL) than in the group with closure at the uterine level (UL) (108.5, 70, 60, 109.38±33.03 mL respectively) **[7,8 ,10,11]**.

On the contrary, the amount of blood loss in the uterine artery ligation group in the study conducted by Abo-Hashem et al. (2021) was lower as compared to the conventional THL group (97.67 ± 34.31 ml and 104.33 ± 39.19 ml), but it didn't reach a statistically significant value **[9]**.

Also, in Pan *et al.'s* study who found no statistically significant difference of blood loss in both groups, where TLH was (177.2±80) ml and TLH with coagulation of uterine artery at its origin was (154.9±30.2) ml **[11]**.

In the current study, there was no statistically significant difference between the two study groups regarding the mean preoperative and postoperative hemoglobin levels. Also, the percentage of hemoglobin deficit was comparable

between the two groups (p= 0.905), with a very small percentage of hemoglobin drop.

This came in accordance with Uccella et al (2021), who showed that preoperative and postoperative hemoglobin levels did not differ between the UL and OR groups. The mean difference in hemoglobin drop between groups was −0.04 g/dL (95% CI −0.29 to 0.22 g/dL; p = 0.77) **[7]**.

In the current study, there was no statistically significant difference between the two study groups regarding the incidence of postoperative complications although the overall incidence was lower in early uterine artery occlusion group (10.7% versus 25.9%).

This cope with Poojari et al. (2014) who showed that there were no major complications in both groups. One patient in Group B with multiple fibroids and previous 2 lower segment cesarean section (LSCS) had bladder injury, detected postoperatively, and was treated conservatively with catheterization for 2 weeks **[8]**.

Also, Sinha et al. study recorded one patient suffering from secondary hemorrhage and vault suture. In group of classical TLH, there were two patients suffering from blood loss and need 4 unit blood transfusions **[9]**.

The results of the current results came in accordance with Uccella et al. who reported that regarding the complications, a single case of intraoperative complication was recorded in each group, and both were recognized and managed laparoscopically during primary surgery. The incidence of minor and major postoperative complications was similar between the UL and OR groups (10% [9/90] vs 6.6% [6/90]; p = 0.37). Six (6.6%) vaginal cuff complications were observed in the UL group vs two (2%) in the OR group (p = 0.28) **[7]**.

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CONCLUSION

Improvements in surgical proficiency and tool development have contributed to the rise of TLH as a method of hysterectomy. Ensuring uterine artery pedicle during the procedure is challenging. Shorter operative time and less intraoperative bleeding are two benefits of early uterine artery ligation at its origin at the beginning of the procedure. Our results, however, need to be confirmed by larger, randomized, multicenter studies.

CONFLICT OF INTEREST

The authors declare no conflict of interest.

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