Single Pedicle Ligation; A New Surgical Technique to Lower Hospital Cost of Abdominal Hysterectomy among Developing Countries – A Pilot Study

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Abstract

Background: Although minimally invasive approaches to hysterectomy are the preferred route, an open abdominal hysterectomy remains an important surgical option for some patients.

Objective: Assessment of single pedicle ligation as a new surgical technique aiming to decrease abdominal hysterectomy related bleeding and costs among developing countries compared with conventional sutures.

Patients and Methods: A total of 40 women candidates for elective total abdominal hysterectomy and/or bilateral salpingio-oophorectomy were enrolled and divided into two equal groups. Group A (control group) was subjected to classic technique and group B (study group) subjected to single pedicle ligation technique. After surgery, both groups were compared regarding number of polyglactin 910 suture ampoules used all over the surgery and estimated blood loss.

Results: The study revealed that although there were differences favouring this new surgical technique over classic surgical technique, as drop 0.78% less in Hematocrit value, 4%less in mean estimated blood loss , 25% less in drain use and 25% less blood transfusion.But these results had no statistical significant difference.

Conclusion: In women undergoing abdominal hysterectomy single pedicle ligation surgical technique help in lowering surgical related blood loss and costs with no statistically significant difference compared with traditional methods.

Keywords: Single Pedicle Ligation; Abdominal Hysterectomy; Developing Countries.

INTRODUCTION

The surgical operation known as hysterectomy is often performed on a global scale. Hysterectomy is most often performed for symptomatic uterine leiomyomas (51.4%), abnormal uterine hemorrhage (41.7%), endometriosis (30%), and prolapse (18.2%), but there may be some in-

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stances when these criteria overlap (Huang et al., 2020).

Hysterectomies may be performed by several methods, including vaginal, laparoscopic approaches (such as complete laparoscopic hysterectomy with or without robotic assistance or laparoscopically assisted vaginal hysterectomy), or abdominal approaches (Eggemann et al., 2018).

Analysis of U.S. surgical data between 1998 and 2010 sheds light on evolving practice patterns in this area and underscores a trend of the decreasing number of hysterectomies performed through the abdominal route—from 65% to 54% during this period—in favor of minimally invasive techniques (Lin et al., 2021).

The obstetrician–gynecologist should discuss the options with the patient and make clear recommendations on which route of hysterectomy will maximize benefits and minimize risks given the specific clinical situation (Higgins et al., 2022).

Although minimally invasive approaches to hysterectomy are the preferred route, open abdominal hysterectomy remains an important surgical option for some patients (Polen-De et al., 2021).

Open abdominal hysterectomy may be necessary when the vaginal or laparoscopic approach is not appropriate to manage the patient's clinical situation, when facilities cannot support less invasive surgical approaches, or when an attempt at a minimally invasive route to hysterectomy fails intraoperatively (Ali et al., 2019).

The occurrence of bleeding issues after a hysterectomy is influenced by many factors. The median range of expected blood loss during abdominal hysterectomy, as determined by randomized studies, is 238-660.5 ml. There exists a correlation between various blood loss parameters, such as transfusion, decline in hemoglobin, hematoma, and vascular injury. Additionally, numerous variables have been identified as contributing to the escalation of bleeding complications. These variables encompass the proficiency of the surgeon, the volume of the surgeon's practice, the surgical volume of the hospital, and the surgical technique employed (Naveiro-Fuentes et al., 2018).

AIM OF THE WORK

This study aims to assess single pedicle ligation as a new surgical technique aiming to decrease abdominal hysterectomy related bleeding and to reduce of the surgery Cost in developing countries as decrease vicryl ampoules numbers and keeping all the pedicles by the same knot reduces the incidence of bleeding in-between the pedicles and double securing of the pedicles.

PATIENTS AND METHODS

This interventional study (pilot study) was conducted at Obstetrics and Gynecology Department, Faculty of Medicine, Ain Shams University Hospitals from April 2023 till February 2024. A total of 40 women were enrolled and divided into two equal groups. To achieve the objective, pilot study was conducted on at least 40 women; they were subdivided into 2 equal groups (20 women in the standard abdominal hysterectomy and 20 women in the single pedicle ligation group) including (the dropout rate.

Inclusion criteria:
Age: 40-60 years old, Women candidate for elective total abdominal hysterectomy and/or bilateral salpingio-oophorectomy for any cause as abnormal uterine bleeding due to uterine fibroids or endometrial hyperplasia or dysfunctional uterine bleeding resistant to medical treatment, adenomyosis resistant to medical treatment.

Exclusion criteria:
Women unfit for surgery, women with chronic debilitating disease, women with bleeding

tendency or taking anticoagulant therapy, women refusing to participate or sign informed consent, pelvic inflammatory disease (PID), endometriosis, diffuse intra-abdominal adhesions necessitating extensive dissection, gynecological cancer/ sarcoma.

Study interventions and procedures:

a) Complete history taking of clinical importance including:

Personal history: age, residence, occupation, marital status and special habits as smoking, alcohol, etc, **present history** of bleeding or pain including onset, duration, and criteria of pattern, **menstrual history:** day of last menstrual period, regularity and amount of bleeding, **obstetric history:** gravidity, parity, previous miscarriages or obstetric complications, **contraceptive history:** type, duration of use before pregnancy, **medical history:** medical comorbidities with pregnancy as hepatic, renal, endocrinal, psychosocial condition, cardiovascular, diabetes, chronic hypertension, **surgical history:** Previous cesarean sections and its neonatal outcomes, **family history** of maternal or fetal complications with pregnancy.

b) Clinical examination with special emphasis on:

General (pulse, blood pressure and temperature), cardiac, chest, neurological, abdominal, lower limb and pelvic examinations in a form of bimanual and speculum examination to detect any abnormal findings and to exclude any local cause of bleeding or pain.

c) Investigation:

Routine investigations as complete blood picture, liver and kidney function tests, coagulation profile "prothrombin time (PT), partial thromboplastin time (PTT) and international normalized ratio (INR)", viral hepatitis markers: hepatitis B and C viruses, Blood group (ABO) and Rh, urinalysis, ECG and chest X-ray examination, cervical Pap smear, endometrial sampling if indicated.

d) **Imaging:** Transvaginal and pelvic ultrasounds were done by Samsung HS60 ultrasound device in Ain Shams University Maternity Hospital to detect conditions such as uterine fibroids, adenomyosis, and endometriosis.

e) All ultrasound examinations were done by an expert and professional medical personnel to ensure the accuracy of examination results.

1. A total of 2 units of packed RBCs were reserved after making ABO matching.
2. Surgical procedure in both groups:

- The procedure team was lecturer and assistant lecturer or senior resident. The surgery team was fixed to avoid variation in the technique.
- The patient was positioned supine on the operation table and spinal anesthesia was used unless contraindicated.
- Sterilization, catheterization and toweling.
- Laparotomy and development of the visual field.
- Clamping and cutting of the round ligament.
- Double clamping, cutting, and ligation of the ovarian ligament and Fallopian tube (or the infundibulopelvic ligament) using coated, synthetic, absorbable, polyglactin 910, braided, 0 or 1, dyed, 75 cm, curved rounded needle (Vicryl®; EGYSORB, Egypt) all over the surgery.
- Mobilization of the bladder.

► Then in group A:

- Clamping, cutting, and ligation of the uterine artery and vein using coated, synthetic, absorbable, polyglactin 910, braided, 0 or 1, dyed, 75 cm, curved rounded needle (Vicryl®; EGYSORB, Egypt) all over the surgery
- Pushing down the cutting stump with gauze.

- Clamping, cutting, and ligation of the sacrouterine ligament and the posterior half of the cardinal ligament using coated, synthetic, absorbable, polyglactin 910, braided, 0 or 1, dyed, 75 cm, curved rounded needle (Vicryl®; EGYSORB, Egypt) all over the surgery.
- Clamping, cutting, and ligation of the vesicouterine ligament and the anterior half of the cardinal ligament using coated, synthetic, absorbable, polyglactin 910, braided, 0 or 1, dyed, 75 cm, curved rounded needle (Vicryl®; EGYSORB, Egypt) all over the surgery.
- Clamping of the boundary between the portio vaginalis and the vagina
- Incision of the vagina and removing the uterus.
- Disinfection of the vagina and closure of the vaginal cuff using coated, synthetic, absorbable, polyglactin 910, braided, 0 or 1, dyed, 75 cm, curved rounded needle (Vicryl®; EGYSORB, Egypt) all over the surgery.

► While in group B 'single pedicle ligation': Aiming to use 2 ampoules of coated, synthetic, absorbable, polyglactin 910, braided, 1, dyed, 75 cm, curved rounded needle (Vicryl®; EGYSORB, Egypt) all over the surgery.

- Clamping, division and ligation of uterine vessels with Vicryl 1 suture (keeping the Vicryl threads intact).
- Clamping, division and ligation of Mackenrodt's ligament to the previous knot (keeping the Vicryl threads intact).
- Clamping, division and ligation of paravaginal tissue to the previous knot (keeping the Vicryl threads intact).
- Opening of vaginal cuff, removal of the uterus and closure of vaginal vault with the previous Vicryl 1 threads.

► Then in both groups;

- Hemostasis
- Closure of the abdominal wall:
- Closing the rectus sheath with a continuous looped suture using of coated, synthetic, absorbable, polyglactin 910, braided, 1, dyed, 75 cm, curved rounded needle (Vicryl ; EGYSORB, Egypt).
- Subcutaneous wound closure using interrupted technique of suturing using of coated, synthetic, absorbable, polyglactin 910, braided, 0, dyed, 75 cm, curved rounded needle (Vicryl®; EGYSORB, Egypt).
- Closing the skin using Ethicon®; PROLENE Polypropylene Suture, 8411H, Synthetic Non-absorbable, CT-2 (26 mm), 1/2 Circle needle.

Statistical analysis

Recorded data were analyzed using the statistical package for social sciences, version 23.0 (SPSS Inc., Chicago, Illinois, USA). The quantitative data were presented as mean± standard deviation and ranges when their distribution was parametric (normal) while non-normally distributed variables (non-parametric data) were presented as median with inter-quartile range (IQR). Also qualitative variables were presented as number and percentages. Data were explored for normality using Kolmogorov-Smirnov and Shapiro-Wilk Test. The p-value was considered significant as the following: P-value <0.05 was considered significant, P-value <0.001 was considered as highly significant, P-value >0.05 was considered insignificant.

RESULTS

Table 1: Comparison between Group A: Control group and Group B: Study group according to Demographic data.

Demographic data	Group A: Control group (n=20)	Group B: Study group (n=20)	Test value	p-value	Sig.
Age "years"					
Mean±SD	47.00±4.40	46.45±3.72	0.182	0.672	NS
Range	42-56	40-53			
BMI [wt/ ht^2]					
Mean±SD	28.30±6.23	27.69±4.71	0.124	0.727	NS
Range	20-44	23-41			
Wt. (kg)					
Mean±SD	81.45±15.98	78.85±10.78	0.364	0.550	NS
Range	60-120	65-105			
Height (cm)					
Mean±SD	1.63±0.06	1.63±0.04	0.000	1.000	NS
Range	1.5-1.7	1.6-1.7			

Using: t-Independent Sample t-test for Mean±SD;
NS: Non significant

Table 2: Comparison between group A: Control group and Group B: Study group according to premenopause, postmenopause, myoma, adenomyosis and endometrial hyperplasia without atypia.

	Group A: Control group (n=20)	Group B: Study group (n=20)	Test value	p-value	Sig.
Premenopause	19 (95.0%)	19 (95.0%)	0.000	1.000	NS
Postmenopause	1 (5.0%)	1 (5.0%)	0.000	1.000	NS
Myoma	17 (85.0%)	14 (70.0%)	1.290	0.256	NS
Adenomyosis	2 (10.0%)	6 (30.0%)	2.500	0.114	NS
Endometrial hyperplasia without atypia	2 (10.0%)	0 (0.0%)	2.105	0.147	NS

Using: x2: Chi-square test for Number (%) or Fisher's exact test, when appropriate
NS: Non significant

Table 3: Comparison between Group A: Control group and Group B: Study group according to Hematocrit (Hct) before and after operation& Drop of Hematocrit.

AAW	Group A: Control group (n=20)	Group B: Study group (n=20)	Test value	p-value	Sig.
Before operation					
Mean±SD	35.22±2.88	35.44±5.75	0.022	0.882	NS
Range	29-39.8	28.6-54			

After operation					
Mean±SD	30.01±3.07	31.00±5.40	0.508	0.480	NS
Range	23-34	24-45			
Drop of HCT					
Mean±SD	5.22±2.88	4.44±1.88	1.016	0.320	NS
Range	1.1-11	1.2-9			

Using: t-Independent Sample t-test for Mean±SD;
NS: Non significant.

This table shows drop of Hematocrit 0.78% less in group B but without statistically significant difference between both groups, with p-value (p>0.05).

Table 4: Comparison between Group A: Control group and Group B: Study group according to Estimated Blood loss.

Estimated Blood loss	Group A: Control group (n=20)	Group B: Study group (n=20)	Test value	p-value	Sig.
Mean±SD	243.30±131.13	221.85±78.04	0.395	0.533	NS
Range	60-455	59-354			

Using: t-Independent Sample t-test for Mean±SD;
NS: Non significant

This table shows 4% less in the mean estimated blood loss in group B, but without statistically significant difference between both groups with p-value(p>0.05).

Table 5: Comparison between Group A: Control group and Group B: Study group according to No. of vicryl 0, No. of vicryl 1.

	Group A: Control group (n=20)	Group B: Study group (n=20)	Test value	p-value	Sig.
No. of vicryl 0					
Median (IQR)	3 (3-4)	3 (3-4)	0.428	0.517	NS
Range	1-5	1-4			
No. of vicryl 1					
Median (IQR)	5 (4-6)	5 (4-7)	0.631	0.432	NS
Range	1-8	3-8			

Using: Mann-Whitney test
NS: Non significant.

Table 6: Comparison between Group A: Control group and Group B: Study group according to Drain.

Drain	Group A: Control group (n=20)	Group B: Study group (n=20)	Test value	p-value	Sig.
No	9 (45.0%)	14 (70.0%)	2.558	0.110	NS
Yes	11 (55.0%)	6 (30.0%)			

Using: x2: Chi-square test for Number (%) or Fisher's exact test, when appropriate
NS: Non significant.

This table shows 25% less in drain use in group B, but without statistically significant difference with p-value (p>0.05).

Table 7: Comparison between Group A: Control group and Group B: Study group according to Blood transfusion after operation.

Blood transfusion	Group A: Control group (n=20)	Group B: Study group (n=20)	Test value	p-value	Sig.
No	**13 (65.0%)**	**18 (90.0%)**	3.584	0.058	NS
Yes	**7 (35.0%)**	**2 (10.0%)**			

Using: x2: Chi-square test for Number (%) or Fisher's exact test, when appropriate
NS: Non significant.

This table shows 25% less blood transfusion in group B, but without statistically significant difference with p-value (p>0.05).

DISCUSSION

Hysterectomy is the second most frequently performed surgical procedure for women of reproductive age (Gartner et al., 2018). Regardless of the surgical technique used, it is associated with short- and long-term (Lin et al., 2021).

Consequently, this study was conducted to assess efficacy of single pedicle ligation as a new surgical technique in decreasing bleeding, related number of polyglactin 910 suture ampoules used and costs of abdominal hysterectomy among developing countries.

This interventional pilot study was conducted at Ain Shams University Maternity Hospital during period from April 2023 till February 2024. A total of 40 participates candidate for elective total abdominal hysterectomy and/or bilateral salpingio-oophorectomy were enrolled and divided into 2 equal groups. Group A (control group) was subjected to classic surgical technique and group B (study group) subjected to single pedicle ligation suturing technique. After surgery, both groups were compared regarding estimated blood loss and total number of polyglactin 910 suture ampoules used all over the surgery.

Our study revealed that although there were differences favouring this new surgical technique over classic surgical technique; as drop 0.78% less in Hematocrit value,4% less in mean estimated blood loss , 25% less in drain use and 25% less blood transfusion.But these results had no statistical significant difference.

Regarding our knowledge, no previous studies assessed the efficacy of single pedicle ligation as a new surgical technique in decreasing abdominal hysterectomy related bleeding and costs.

Dutta and Dutta (2014) in acomparative prospective study that was undertaken at Multicare hospital and J.N.M hospital, Kalyani West- Bengal, India during the period from January 2000 to December 2009. During this period 1000 abdominal hysterectomy operation were performed by this procedure (Group A) and 450 (Group B) by conventional method, reported that ligation of uterine and ovarian arteries, prior to conventional abdominal hysterectomy procedures is found to be extremely safe procedure thereby reducing the risk of intra-operative and post- operative complications such as haemorrhage caused by trauma or slipping and retraction of uterine arteries and ovarian arteries are of great concern to a gynecologist working especially in rural settings where there infrastructure and facilities like blood transfusion etc are not available easily.

In this method, no traumatic injury of left and right ovarian vessels were reported, only 0.4% cases which had traumatic injury to left

uterine vessel and 0.3% cases with right uterine vessel which was managed immediately. This has got no significance statistically.

Aziz et al. (2022) showed in a randomized single blind controlled trial was carried on 70 women undergoing total abdominal hysterectomy. They were randomly allocated in two equal groups: misoprostol group: patients received two tablets of Misoprostol (=200 μg) 30 minutes before operation and a control group (placebo group): patients received two tablets of Placebo 30 minutes before operation.

Haemoglobin and Haematocrit reductions were significantly lower among misoprostol group than among placebo group.

Regarding preoperative haemoglobin and haematocrit, the study discovered no significant variation among the studied groups,but postoperative haemoglobin and haematocrit were significantly elevated among the misoprostol group rather than the placebo group . Regarding blood loss(ml), it was significantly decreased among the misoprostol group in contrast to placebo group. Regarding side effects among the studied groups, Nausea & vomiting were significantly more frequent among the misoprostol group than the placebo group while diarrhea, headache, fever and shivering were non-significantly prevalent with the misoprostol group in contrast to the placebo group.

That agrees with Tabatabai and colleagues (2015) in double blind randomized clinical trial was conducted with 80 candidates for abdominal hysterectomy, used a 400-microgram rectal dose before TAH and demonstrated that a single rectal misoprostol dose significantly reduced peri-operative bleeding in comparison to a placebo.

This disagree with Chai and colleagues (2011) who designed a pilot study on 64 TAH women and didn't give any significant decrease in intraoperative blooding during TAH when compared to placebo (570 mL vs 521 mL; P = 0.904); This may be due to not excluding females with major adhesions and a fewer sample.

Parashi & Astaraei (2022) aimed to investigate the effect of a single preoperative dose of sublingual misoprostol on reducing blood loss during total abdominal hysterectomies.

In a single-blind randomized controlled trial (RCT), The statistical population included all women who were candidates of hysterectomy in 2017 and 2018. A total of 132 patients were randomly selected and classified into two groups of misoprostol (N=66) and placebo (N=66). Examining intraoperative blood loss was considered a primary outcome. Moreover, levels of hemoglobin before and 24 hours after the surgery, the need for a blood transfusion, febrile morbidity, and the duration of hospitalization were regarded as secondary outcomes. The mean of hemoglobin values was lower in the placebo group compared to the misoprostol one, and this difference was statistically significant ($P < 0.001$). There was a significant difference in intraoperative blood loss between the two groups, and it was significantly higher

Topsoee et al. (2015) showed in adouble-blinded randomized placebo-controlled trial conducted on atotal of 332 women, that the primary outcome of intraoperative total blood loss was reduced in the group treated with tranexamic acid compared to the placebo group when estimated both subjectively by the surgeon and objectively by weight (98.4 mL vs 134.8 mLand 100.0 mL vs 166.0 mL). The incidence of blood loss ≥500 mL was also significantly reduced (6 vs 21), as well as the use of open-label tranexamic acid (7 vs 18). Furthermore, the risk of reoperations owing to postoperative hemorrhage was significantly reduced in the tranexamic acid group compared to the placebo group (2 vs 9). This corresponds to an absolute risk reduction of 4.2% and number needed to treat of 24. No incidence of thromboembolic events or death was observed in any of the groups.

This reported that prophylactic treatment with tranexamic acid reduces the overall total blood loss, the incidence of substantial blood loss, and the need for reoperations owing to postoperative hemorrhage in relation to benign hysterectomy. No incidences of serious adverse events occurred.

Nivedhana et al. (2018) in arandomized, double-blind, placebo-controlled study that conducted on hundred patients undergoing abdominal hysterectomy. Group T (n = 50)-received TXA 15 mg/kg in 100 ml Normal saline and Group N (n = 50) received the same volume of Normal saline infused over 15 minutes. Estimated blood loss, need for blood transfusion, duration of surgery, postoperative hemoglobin and incidence of adverse events were noted.

There was statistically significant reduction in mean blood loss in group T when compared to group N (360 ml versus 540 ml). Accordingly, there was significant difference in the number of patients requiring blood transfusion (12% versus 42%) and also the postoperative hemoglobin levels. The group T patients had a significantly shorter operating time (127.86 versus 148.64 minutes). None of the patients developed any major adverse events.

CONCLUSION

In women undergoing abdominal hysterectomy, single pedicle ligation surgical technique help in lowering surgical related estimated blood loss and costs although no statistically significant difference compared with classic traditional method.

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