SCIENTIFIC PAPER

Effects of Electrosurgery and Vaginal Closure Technique on Postoperative Vaginal Cuff Dehiscence

James Fanning, DO, Joshua Kesterson, MD, Matthew Davies, MD, Janis Green, MD, Lindsey Penezic, MD, Roberto Vargas, MD, Gerald Harkins, MD

ABSTRACT

Background and Objectives: The aim of our study is to evaluate the role of electrosurgery and vaginal closure technique in the development of postoperative vaginal cuff dehiscence.

Methods: From prospective surgical databases, we identified 463 patients who underwent total laparoscopic hysterectomy (TLH) for benign disease and 147 patients who underwent laparoscopic-assisted vaginal hysterectomy (LAVH) for cancer. All TLHs and LAVHs were performed entirely by use of electrosurgery, including colpotomy. Colpotomy in the TLH group was performed with Harmonic Ace Curved Shears (Ethicon Endo-Surgery, Cincinnati, OH, USA), and in the LAVH group, it was performed with a monopolar electrosurgical pencil. The main surgical difference was vaginal cuff closure—laparoscopically in the TLH group and vaginally in the LAVH group.

Results: Although patients in the LAVH group were at increased risk for poor healing (significantly older, higher body mass index, more medical comorbidities, higher blood loss, and longer operative time), there were no vaginal cuff dehiscences in the LAVH group compared with 17 vaginal cuff dehiscences (4%) in the TLH group ($P = .02$).

Conclusion: It does not appear that the increased vaginal cuff dehiscence rate associated with TLH is due to electrosurgery; rather, it is due to the vaginal closure technique.

Division of Gynecologic Oncology (Drs. Fanning, Kesterson), Minimally Invasive Surgery Group (Drs. Davies, Green, Harkins), and Department of Obstetrics and Gynecology (Drs. Penezic, Vargas), Pennsylvania State University, Milton S. Hershey Medical Center, Hershey, PA, USA.

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Address correspondence to: James Fanning, DO, Division of Gynecologic Oncology, Department of Obstetrics and Gynecology, Pennsylvania State University, Milton S. Hershey Medical Center, 500 University Dr, Room C-3620, Hershey, PA 17033, USA. Telephone: (717) 531-8144, Fax: (717) 531-0007, E-mail: jfanning1@hmc.psu.edu

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INTRODUCTION

Advanced laparoscopic procedures are increasingly being used as an alternative for laparotomy in gynecologic surgery.[1–7] A meta-analysis of 27 prospective randomized trials has proven the benefits of laparoscopic compared with abdominal gynecologic surgery: decreased pain, decreased surgical-site infections, decreased hospital stay, quicker return to activity, and fewer postoperative adhesions.[8] Though originally more costly, with increasing experience, the length of laparoscopic procedures has shortened, resulting in costs similar to laparotomy.[9]

A complication that is significantly increased with total laparoscopic hysterectomy (TLH) and robotic hysterectomy is vaginal cuff dehiscence—partial or total separation of the edges of the vaginal cuff with or without bowel evisceration. In a review from Magee-Women's Hospital, the rate of vaginal cuff dehiscence increased from 0.1% with abdominal hysterectomy to 5% with TLH (relative risk, 53).[10] In a review from the Mayo Clinic, the rate of vaginal cuff dehiscence increased to 4% with robotic hysterectomy.[11]

Although the cause of the higher incidence of vaginal cuff dehiscence associated with TLH and robotic hysterectomy is unknown, numerous authors have proposed that impaired wound healing due to thermal damage from electrosurgical devices used for colpotomy and/or vaginal closure technique issues, including shallow suture placement, decreased knot security, and suture fraying, may play a role.[10–13] The aim of our study is to evaluate the role of electrosurgery and vaginal closure technique in the development of postoperative vaginal cuff dehiscence.

MATERIALS AND METHODS

Over a 2.5-year period (2009–2011), all patients undergoing gynecologic oncology (GO) and minimally invasive surgery (MIS) were entered into two prospective surgical databases. Demographic characteristics were obtained and entered preoperatively, surgical outcomes were en-

tered immediately postoperatively, and follow-up was entered at each postoperative encounter.

From the prospective surgical databases, we identified 463 patients who underwent TLH by MIS and 147 patients who underwent laparoscopic-assisted vaginal hysterectomy (LAVH) by GO. No cases were excluded. Penn State Milton S. Hershey Medical Center Institutional Review Board approval was obtained.

All TLHs and LAVHs were performed entirely by use of electrosurgery, including colpotomy: PlasmaKinetic (PK) cutting forceps (Gyrus ACMI, Southborough, MA, USA), Harmonic Ace Curved Shears (Ethicon Endo-Surgery, Cincinnati, OH, USA), and monopolar electrosurgical pencil (colloquially referred to as "electrocautery," "cautery," or "Bovie"). The PK cutting forceps is a bipolar electrosurgical sealing device that was used on the PK mode at 35 W. The Harmonic Ace Curved Shears are an acoustic transducer that converts electrical energy into ultrasonic energy that was used at power levels 3 through 5. The monopolar electrosurgical pencil (Valleylab, Mansfield, NH, USA) was used at 50 W, blend 1, coagulation mode.

The main surgical difference was vaginal cuff closure: TLH vaginal cuff closure was performed laparoscopically, and LAVH vaginal cuff closure was performed vaginally.

In the GO LAVH group, all patients underwent a preoperative bowel preparation with 1 bottle of magnesium citrate, received a single dose of prophylactic antibiotics, received pneumatic compression stockings, and underwent early ambulation. Unless contraindicated, all patients received ketorolac (Toradol, Syntex Corp, Palo Alto, CA, USA), 30 mg intravenously (IV), at the completion of surgery; morphine, 2 to 5 mg IV every 2 hours as needed; and oxycodone/acetaminophen (Percocet), 5/325 mg, 1 to 2 tabs, orally every 6 hours as needed for analgesia. On postoperative day 1, patients were given bowel stimulation with 30 mL of milk of magnesia, were started on a general diet, and were discharged when oral intake was adequate. Patients were followed up in the office at 1 and 4 weeks after surgery.

In the GO LAVH group, all procedures were performed under general endotracheal anesthesia. An orogastric tube was inserted and removed at the end of surgery. A 4-port (5-mm) transperitoneal approach was used: periumbilical, right and left lower quadrant, and left upper quadrant. Round ligaments, infundibulopelvic ligaments, uterine vessels, and cardinal and uterosacral ligaments were sealed and divided with the PK cutting forceps. The laparoscopic 5-mm Argon-Beam Coagulator (ValleyLab, Boulder, CO, USA) was used to perform the lymphadenectomy. The Argon-Beam Coagulator was used at a setting of 80 W and an argon gas flow setting at 4 L/min. The patient's legs were repositioned for the vaginal portion. The cervicovaginal junction (colpotomy) was opened with the monopolar electrosurgical pencil. The anterior and posterior culs-de-sac were entered with the monopolar electrosurgical pencil, the remaining cardinal and uterosacral ligaments were excised with the monopolar electrosurgical pencil and sutured (No. 0 polyglactin 910), and the specimen was removed. Bilateral interrupted uterovaginal fixation sutures (No. 0 polyglactin 910) were placed, incorporating 2 cm of vaginal tissue (half the length of a CT-1 needle, Ethicon Inc, San Angelo, TX, USA). The posterior cuff was sutured with a continuous suture (No. 0 polyglactin 910) incorporating 2 cm of vaginal tissue. Reperitonealization was performed with a purse-string suture (No. 3–0 polyglactin 910). The vaginal cuff was closed with a continuous suture (No. 0 polyglactin 910) incorporating 2 cm of vaginal tissue. Surgical assistance was provided by a gynecologic resident.

In the MIS TLH group, all patients underwent a preoperative bowel preparation with either 1 bottle of magnesium citrate, Fleet enema (Fleet Laboratories, Lynchburg, UA, USA) or Dulcolax (Boehringer-Ingelheim Pharmaceuticals, Cleveland, OH, USA) suppository. As part of routine preoperative care, all patients received a single dose of prophylactic antibiotics, received pneumatic compression stockings, and underwent early ambulation. Unless contraindicated, the postoperative pain management protocol consisted of ketorolac, 30 mg IV, at completion of surgery; morphine, 2 to 4 mg IV every 2 hours as needed; and oxycodone, 5 to 10 mg orally every 4 hours. The patients were immediately started on a regular diet on postoperative day 0, and intravenous fluids were discontinued once adequate oral hydration was achieved. Patients were followed up 6 weeks after surgery.

In the MIS TLH group, all procedures were performed under general endotracheal anesthesia. An orogastric tube was inserted and removed at the end of surgery. The patient was positioned in the dorsolithotomy position directly on egg crate foam with the legs in Ultrafin stirrups (Allen Medical Systems, Acton, MA, USA) and placed in maximal Trendelenburg position (approximately 30°). A 3-port (10-mm) transperitoneal approach was used: intraumbilical, right lower quadrant, and left lower quadrant. Harmonic Ace Curved Shears were used to ligate the triple pedicle (fallopian tube, round ligament, and utero-ovarian ligament), skeletonize the uterine artery, ligate the uterine artery, ligate the cardinal and uterosacral ligaments, and incise the vaginal colpotomy. The vaginal cuff was reapproximated by use of No. 2–0 polyglactin 910 in a continuous running fashion with Lypra Ty II

(Ethicon, Cincinnati, OH, USA) incorporating 7.5 mm of vaginal tissue (the length of the tips of a laparoscopic Kocher grasper). Surgical assistance was provided by a gynecologic resident.

All patients in both groups were told not to have vaginal intercourse until after the 4- to 6-week postoperative examination.

On the basis of previous studies, vaginal cuff dehiscence was defined as partial or total separation of the edges of the vaginal cuff with or without bowel evisceration.

When comparing the LAVH and TLH groups, we used a 2-tailed *t* test for continuous variables and Fisher exact test for discreet variables.

RESULTS

Demographic characteristics and operative findings of the 463 patients who underwent TLH and 147 patients who underwent LAVH are presented in **Tables 1** and **2**. Diagnoses in the MIS TLH group were as follows: fibroids (30%), endometriosis (25%), uterine bleeding (23%), pain (13%), and other (9%). Diagnoses in the GO LAVH group were as follows: endometrial cancer (76%), ovarian mass (12%), ovarian cancer (5%), and other (7%). Patients in the LAVH group were significantly older (59 years vs 40 years, $P = .001$), had a higher body mass index (34 kg/m^2 vs 28 kg/m^2, $P = .05$), had more medical comorbidities (75% vs 45%, $P = .001$), had higher blood loss (100 mL vs 50 mL, $P = .001$), and had a longer operative time (1 hour 30 minutes vs 1 hour 4 minutes, $P = .001$). The length of hospital stay was similar between the groups (1 day vs 0.8 days, $P = .16$).

There were 17 vaginal cuff dehiscences (4%) in the TLH group and no vaginal cuff dehiscences in the LAVH group ($P = .02$). Diagnoses in the vaginal cuff dehiscence group were as follows: fibroids (40%), endometriosis (40%), uterine bleeding (18%), and pain (12%). The median age was 33 years (range, 25–49 years). Vaginal cuff dehiscence was associated with vaginal intercourse in 13 cases (76%). The median time to vaginal cuff dehiscence was 31 days (range, 4–86 days). In 13 cases (76%) repair was required in the operating room. The median size of the vaginal cuff dehiscence was 3 cm (range, 1–4 cm). Of the 17 vaginal cuff dehiscences, 5 (30%) had associated evisceration of the bowel and/or omentum.

Table 1.
Patient Demographic Characteristics

	LAVH	TLH	*P* Value
No. of patients	147	463	
Diagnosis			
Endometrial cancer	76%		
Ovarian mass	12%		
Ovarian cancer	5%		
Other	7%		
Fibroid		30%	
Endometriosis		25%	
Bleeding		23%	
Pain		13%	
Other		9%	
Age (y)	59 (21–89)	40 (25–88)	.001
Body mass index (kg/m^2)	34 (38–70)	28 (27–54)	.05
Medical comorbidity	75%	45%	.001

Table 2.
Operative Findings

	LAVH	TLH	*P* Value
Blood loss (mL)	100 (25–1850)	50 (25–2200)	.001
Operative time	1 h 30 min (40 min to 4 h 36 min)	1 h 4 min (35 min to 5 h 15 min)	.001
Length of stay (d)	1 (1–4)	0.8 (0–2)	.16

DISCUSSION

Advanced laparoscopic procedures have been proven to result in fewer complications with less morbidity compared with abdominal gynecologic surgery.[1–9] However, vaginal cuff dehiscence is increased with TLH and robotic hysterectomy.[10–13] Although the cause of the higher incidence of vaginal cuff dehiscence associated with TLH and robotic hysterectomy is unknown, numerous authors have proposed that impaired wound healing due to thermal damage from electrosurgical devices used for colpotomy or the vaginal closure technique probably plays a major role.[10–13] Though not proven in humans, in animal models electrosurgical incisions are associated with impaired healing and increased infections compared with scalpel incisions, believed to be due to increased tissue necrosis and devascularization.[14] Possible vaginal closure technique issues included shallow suture placement, decreased knot security, and suture fraying associated with laparoscopic vaginal closure.

In our study, although patients in the LAVH group were at increased risk for poor healing (significantly older, higher body mass index, more medical comorbidities, higher

blood loss, and longer operative time), there were no vaginal cuff dehiscences in the LAVH group compared with 17 vaginal cuff dehiscences (4%) in the TLH group ($P = .02$). The vaginal cuff dehiscence rate in the TLH group (4%) is the same as that in prior reports of TLH and robotic hysterectomy.[10–13] Because all LAVHs were performed entirely by electrosurgery including colpotomy and there were no vaginal cuff dehiscences in the LAVH group, it does not appear that electrosurgery plays a major role in vaginal cuff dehiscence. Interestingly, colpotomy was performed with the Harmonic Ace Curved Shears in the TLH group and with the monopolar electrosurgical pencil in the LAVH group. Theoretically, the Harmonic Ace Curved Shears should produce less vaginal tissue damage than the monopolar electrosurgical pencil because the shears use ultrasonic energy.

However, there was a major difference in vaginal closure between the LAVH and TLH groups. Vaginal closure in the LAVH group was performed in 4 layers (uterovaginal fixation, posterior cuff, reperitonealization, and anterior/posterior vagina), with No. 0 polyglactin 910 suture and 2-cm bites. Vaginal closure in the TLH group was performed in 1 layer (anterior/posterior vagina), with No. 2–0 polyglactin 910 suture and 7.5-mm bites. Thus LAVH vaginal cuff closure was performed in more layers, with thicker suture and incorporation of a larger portion of vaginal mucosa. It appears that the vaginal closure technique may play a role in the increased vaginal cuff dehiscence rate associated with TLH. Because of these results, the MIS department has altered its vaginal cuff closure technique. Specifically, vaginal cuff closure suture was changed to No. 2–0 glycolide/lactide copolymer (delayed absorbable) and tissue suture placement was increased to at least 1.5 cm. There has been no further vaginal cuff dehiscence since the initiation of these changes.

A major strength of our study is our prospectively maintained surgical databases, which significantly decreases the chance of bias compared with a retrospective review. Another major strength of our study is that all TLHs were performed by two surgeons (G.H. and M.D.) and all LAVHs were performed by two surgeons (J.F. and J.K.), rather than an entire department, which ensures surgical uniformity. Unfortunately, the time of first vaginal intercourse was not entered into our surgical databases and thus its effect on vaginal cuff dehiscence could not be evaluated.

CONCLUSION

On the basis of our study, it does not appear that electrosurgery is responsible for post-laparoscopic hysterectomy vaginal cuff dehiscence because there were no vaginal cuff dehiscences in the LAVH group. It appears that the vaginal closure technique may play a role in the increased vaginal cuff dehiscence rate associated with TLH.

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