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Electrosurgical Settings and Vaginal Cuff Complications

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ABSTRACT

Background and Objectives: After being encouraged to change the technique for opening the vaginal cuff during robotic surgery, this study was performed to determine the correlation between vaginal cuff complications and electrosurgical techniques.

Methods: The study group consisted of patients who had their vaginal cuffs opened with a cutting current compared to the group of patients having their vaginal cuff opened with a coagulation current. Data were collected on 150 women who underwent robotic surgery for endometrial cancer. All patients received preoperative antibiotics. Data, including operative time, type of electrosurgery used, estimated blood loss, transfusion rate, and complications, were collected from the patients' records.

Results: Surgeries in 150 women and the associated complications were studied. The mean age of the patients was not significantly different between the groups ($P = .63$). The mean body mass index was 38 kg/m^2 in the coagulation arm and 36 kg/m^2 in the cutting arm ($P = .03$). Transfusion was not required. Estimated blood loss and operative time were not significantly different in the coagulation versus the cutting arms ($P = .29$ and .5; respectively). No patients in the cutting arm and 4 patients (with 5 complications) in the coagulation arm had cuff complications ($P = .02$).

Conclusions: Complications involving the vaginal cuff appear to occur more frequently when the vagina is entered by using electrosurgery with coagulation versus cutting in this cohort of patients undergoing robot-assisted surgery for endometrial cancer.

Key Words: Coagulation, Dehiscence, Electrosurgery, Robotic hysterectomy

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INTRODUCTION

The current standard of care for treatment of endometrial cancer is hysterectomy. As minimally invasive hysterectomy techniques become increasingly favored because of the presumed decrease in blood loss, the short recovery time, and reduced postoperative pain, consideration of the complications that follow these procedures is crucial. In particular, recent studies have emphasized that laparoscopic or robotic hysterectomies may yield increased incidences of vaginal cuff complications in comparison to total abdominal hysterectomy (TAH) or total vaginal hysterectomy (TVH).[1] An increased rate of vaginal cuff dehiscence is a recognized complication of robot-assisted hysterectomies at 1.7–4.1%, compared to TAH or TVH at 0.12 and 0.29%, respectively.[2–4] Several theories have been proposed regarding the increase in complication rates. One study has demonstrated that most vaginal cuff separations do not occur as a result of predisposing conditions.[5] Authors have hypothesized that thermal damage from the use of electrosurgery during amputation of the cervix leads to cuff necrosis and devascularization beyond the suture line.[4] Other authors have hypothesized that minimally invasive surgeons take smaller bites of vaginal tissue when closing the cuff because of the enhanced visualization and magnification that distort the perspective, compared with that in open surgery.[1,6]

Necrosis at the vaginal cuff is thought to be the cause of increased vaginal cuff complications in robot-assisted hysterectomy, most specifically in cuff dehiscence.[4] Dehiscence can be defined as full-thickness separation of the anterior and posterior edges of the vaginal cuff, with either partial or total separation of vaginal tissue, with or without bowel evisceration.[1] Although vaginal cuff complications are relatively rare events, continued research in this area is essential to decrease the rate of the more serious complications associated with vaginal dehiscence, such as bowel evisceration and pelvic prolapse. A 2008 study by Magrina and colleagues[7] at Mayo Clinic (Scottsdale, AZ, USA) demonstrated the relationship between electrosurgery and vaginal cuff complications and suggested that the thermal effects of electrocoagulation significantly impair wound healing. This article prompted a change in this group's standard electrosurgical operative technique from coagulation to cutting during the cuff incision.[7] Although this change is accepted among gynecologists and gynecologic oncologists, there has not been a systematic evaluation of improvements in complication rates after robotic hysterectomy. The objective was to evaluate the differences in vaginal cuff complication rates between the coagulation and cutting modes used during robotic hysterectomy. We hypothesized that postoperative complications would be significantly lower in the cutting mode group because of decreased thermal spread.

MATERIALS AND METHODS

The null hypothesis for this study was that there are no differences in vaginal complications, regardless of the electrosurgical technique used. The first 100 women undergoing robotic hysterectomy (and pelvic/para-aortic lymphadenectomy) for endometrial cancer, immediately after the standard operative technique was changed from monopolar coagulation to monopolar cutting for colpotomy, were compared to the immediate 50 women undergoing robotic surgery for endometrial cancer (robotic hysterectomy with pelvic/para-aortic lymphadenectomy) before the switch in techniques. Electrosurgery settings for the procedures in this study were 40 W for the cutting and 30 W for the coagulation modalities (off-label use). In all 150 cases, colpotomy was performed with monopolar current. In all cases, the cuff was closed with 2 to 3 interrupted sutures of polyglycolic acid or equivalent.

If electrical dissection was performed along with sharp and blunt dissection, the current used was parallel to the current used for the colpotomy. Hemostasis was obtained with bipolar current. All patients received 1 dose of preoperative antibiotics, according to hospital guidelines, with the standard being cefoxitin or cefotetan, if the patient was not allergic. No postoperative antibiotics were given. All patients in this study also received postoperative inpatient and outpatient prolonged anticoagulation with either fondaparinux or enoxaparin, depending on the insurance provider. All patients had a postoperative pelvic examination from 4 to 6 weeks after surgery. Earlier pelvic examinations (including speculum examination) were performed for any patient with a specific complaint: bleeding, discharge, leaking, pain, or foul odor, for example. Cuff dehiscence was defined as a separation of the vaginal cuff that included all layers of the vagina and involved either tissue breakdown or suture failure. A small separation between intact sutures was not included. All were cases of 1 attending physician who has been performing robotic surgery since 2005–2006. These cases were collected and analyzed from 2009 through 2010. Data extracted and made unidentifiable included operative time, body mass index, transfusion rate, estimated blood loss, comorbidities, and complications. The study was exempted by the institutional review board. The mode of electrosurgery was changed after a 2008 article provoked discussion and review of complications recorded at our institution.[7]

Table 1.
Overall Demographic Characteristics

Characteristic	Data
Patients (n)	150
Mean age (years)	60
Body mass index (kg/m^2)	36
Hypertension (%)	23
Diabetes known/diagnosed before surgery (%)	17
Oral steroid use (%)	1
Inhaled steroid use (%)	6
Transfusions (n)	0
Overall operating time (min)	130
Estimated blood loss (mL)	220

Statistical analyses were conducted with SPSS (IBM-SPSS Statistics, Armonk, NY, USA). All tests were 2-tailed. The independent *t* test was used to compare baseline variables and Fisher's exact test, to study categorical and normally distributed data. Normality was tested by the Shapiro-Wilk test. For data with a skewed or nonnormal distribution, the Mann–Whitney U test was used. $P < .05$, corresponding to a 95% confidence interval (CI), denoted significance. Results for normally distributed numerical data were presented as the mean with standard deviation (SD). Results for nonnormal data were the median.

RESULTS

One hundred fifty women who had robotic hysterectomy with pelvic and para-aortic lymph node dissection were studied. The mean age of the patients was 61 years in the coagulation group and 60 years in the cutting group ($P = .63$) (**Tables 1** and **2**). The mean body mass index for patients in the coagulation arm was 38 and 36 kg/m^2 in the cutting group ($P = .033$). No transfusions were required in either arm. Mean operative time (131 minutes vs 129 minutes) and mean estimated blood loss (211 mL vs

Table 2.
Demographics by Colpotomy Method

	Coagulation	Cut	P
Mean age (years)	61	60	.63
Body mass index (kg/m^2)	38	36	.03
Hypertension (%)	24	22	.81
Diabetes known/diagnosed before surgery (%)	16	18	.79
Oral steroid use (%)	0	2	.32
Inhaled steroid use (%)	6	6	1
Transfusions (n)	0	0	—
Overall operating time (min)	131	129	.50
Estimated blood loss (mL)	211	228	.29

228 mL) were not significantly different in the coagulation and the cutting groups (P = .5 and 0.29; respectively). Four patients in the coagulation group and no patients in the cutting group had postoperative cuff complications (P = .01). All complications occurred within 6 weeks after surgery and occurred spontaneously without precipitating events. Three patients had dehiscence of the vaginal cuff (separations without bowel evisceration), and 2 had cuff abscess, with 1 having both a documented abscess and cuff dehiscence. None of the cuff dehiscences involved evisceration of the bowel (no bowel came through the cuff separation). None of the separations required secondary closure, and all were allowed to heal by secondary intention. One abscess drained spontaneously (the reason for the patients presenting to the surgeon's office), and the other abscess was drained in the clinic.

DISCUSSION

Experience in teaching residents, fellows, and attendings in practice has shown that most surgeons have a limited working knowledge of electrosurgery. Several authors have explained or demonstrated the danger of this gap in surgical knowledge.[8–11] A lack of understanding can lead to a variety of complications, such as a cuff separation found incidentally during examination, intraoperative thermal bowel or ureter injury, or operating room fires.[8] As an example, up to 600 operating room fires occur nationally each year. In addition, the United States Collaborative Review of Sterilization demonstrated that although effective, monopolar cautery electrosurgical techniques for tubal ligation result in more complications and more technique-related complications than occlusive methods.[12] However, these results have not discouraged the use of unipolar or bipolar coagulation as a technique for elective sterilization. Correspondingly, a fundamental understanding of electrothermal injury, tissue penetration, and the risks associated with the use of alternating current in electrosurgery in the operating room is essential.[9] Electrosurgical or electrothermal injuries during laparoscopy are thought to occur in 0.1–0.5% of cases.[8,13,14] Most of these injuries are not recognized at the time of surgery and can present from days to weeks after the surgery. Therefore, most patients are no longer in the hospital by the time these potentially serious injuries become manifest.

Electrosurgical units use alternating current, whereas electrocautery units use direct current. In electrosurgery, the alternating current enters the patient's body, in contrast with direct current, in which only a heated loop contacts the patient locally.[9] A cutting current is defined as a low-voltage, continuous waveform with 30–80 W of power. A coagulation current has higher voltage (30–60 W) and is a discontinuous waveform, allowing for tissue coagulation.[9] Electrothermal spread is demonstrated to be inversely proportional to voltage. Thus, cutting produces less thermal tissue damage than coagulation.[9] Bipolar electrosurgery is often preferred for achieving hemostasis, because the lower voltage used in these units reduces the extent of thermal spread to collateral tissues in comparison to monopolar electrosurgery.[9] Accordingly, the hysterectomies in our study were performed with monopolar electrosurgery for colpotomy and bipolar methods to achieve hemostasis (along with suturing).

Bristow et al[15] demonstrated in a single patient's tumor that length of application and wattage directly affects the amount and depth of tissue damage when using unipolar energy produced by an argon beam coagulator. When alternating current is specifically considered, the risk of injury is greatest with the unipolar coagulation mode and least with the bipolar cutting mode.[9] Furthermore, Magrina and colleagues[7] have suggested a direct relationship between electrothermal injury and vaginal cuff complications. Intraoperative complications, such as increased blood loss, necessity for blood transfusion, or operative time, were not shown to be significantly different.[7] Applications of these electrosurgical principles have yielded favorable results with respect to decreasing morbidities following hysterectomies. Our study has statistically established that after robotic hysterectomy for endometrial cancer, postoperative complications involving the vaginal cuff occur less frequently when the initial cuff incision is performed with the cutting technique rather than by coagulation.

Methods of achieving vaginal cuff hemostasis are important when considering implications for dehiscence rates. Monopolar coagulation has been demonstrated to cause more electrothermal damage in comparison to bipolar coagulation.[9] Statistical analysis of monopolar versus bipolar coagulation, when used for cuff hemostasis, may provide further insight regarding this concept. In addition, suturing is another effective modality for hemostasis. Sutures can be placed transvaginally; laparoscopically, by using intracorporeal or extracorporeal knots; or by robot-assisted laparoscopy. A 2012 analysis by Uccella et al[5] reported, although the difference in outcome is not statistically significant, laparoscopic sutures produce increased rates of cuff dehiscence versus transvaginal sutures. This finding emphasizes the suturing difficulties associated with magnification and perception errors that are inherent in endoscopic surgical techniques. Suture placement may involve inadequate amounts of vaginal tissue, and the tissue may already be thermally damaged.[16] Furthermore, types of suture used for cuff closure and their affect on cuff dehiscence rates should be further studied. Barbed sutures, polydioxanone sutures, and braided polyglycolic materials have each been proven effective in laparoscopic techniques.[4,5]

A possible limitation of this study involves the uncontrolled variability of power settings for coagulation and cutting on the different electrosurgical units used at our institution. Specific calibration of wattage was not performed or documented. In addition, time of tissue interaction with electrosurgical spatulas may be another source of inconsistency. These variables could affect the extent of thermal damage to vaginal tissues and thus alter rates of cuff dehiscence. Nezhat and colleagues[17] proposed tissue desiccation as a reason for cuff complications when they reported 3 cuff complications in 1996. Another limitation of our study is that all surgeries were performed by 1 surgical team. Thus, information learned from this report is not as generalizable as it would be had this been a multi-institution study.

In conclusion, continuing education and research regarding electrosurgery is imperative for students, residents, and surgical faculty. Performance of cuff incision with coagulation creates higher rates of postoperative vaginal cuff dehiscence and potentially other complications. Further investigation of cuff hemostasis and cuff closure may be beneficial in minimizing complications after hysterectomy in the treatment of endometrial cancer.

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