A Multiinstitutional Experience With Robotic-Assisted Hysterectomy With Staging for Endometrial Cancer

M. Patrick Lowe, MD, Peter R. Johnson, MD, Scott A. Kamelle, MD, Saurabh Kumar, MD, Donald H. Chamberlain, MD, and Todd D. Tillmanns, MD

OBJECTIVE: To report perioperative outcomes and learning curve characteristics from a multiinstitutional experience with robotic-assisted surgical staging for endometrial cancer.

METHODS: A multiinstitutional robotic surgical consortium was created to evaluate the usefulness of robotics for gynecologic oncology surgery. An analysis of a multiinstitutional database of all patients who underwent robotic surgery for endometrial carcinoma between April 2003 and January 2009 was performed. Records were reviewed for demographic data and perioperative outcomes. Individual surgeon outcomes were analyzed as well in an attempt to evaluate characteristics of learning with incorporation of robotic technology.

RESULTS: Four hundred five patients were identified who underwent robotic surgery for endometrial cancer. Mean age was 62.2 years and mean body mass index was 32.4. Fifty-five percent of patients reported a prior abdominal surgery. Final pathologic analysis demonstrated that 89.6% of all patients had stage I and II disease. Mean operative time was 170.5 minutes. Mean estimated blood loss was 87.5 mL. Mean lymph node count was 15.5. Mean hospital stay was 1.8 days. Intraoperative complications occurred in 3.5% of the patients and conversion to laparotomy occurred in 6.7%. Postoperative complications were reported in 14.6% of the patients. For the group, fewer than 10 cases were required to achieve proficiency with the procedure.

CONCLUSION: Robotic technology may level the playing field between the novice and expert laparoscopist for endometrial cancer staging. Prospective trials should be undertaken to compare robotic and laparoscopic approaches to treat endometrial cancer.
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See related case report on page 369.

From the Department of Obstetrics and Gynecology, Division of Gynecologic Oncology, Robert H. Lurie Comprehensive Cancer Center of Northwestern University, Northwestern University, Chicago, Illinois; Gynecologic Oncology, University of Tennessee, Chattanooga, Chattanooga, Tennessee; Department of Obstetrics and Gynecology, University of Wisconsin School of Medicine and Public Health, Aurora Health Center, Milwaukee, Wisconsin; and Department of Obstetrics and Gynecology, University of Tennessee Health Science Center and West Clinic, Memphis, Tennessee.

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Corresponding author: M. Patrick Lowe, MD, Director of Gynecologic Oncology Robotics and Minimally Invasive Surgical Program, Department of Obstetrics and Gynecology, Division of Gynecologic Oncology, Northwestern University, Feinberg School of Medicine, 250 East Superior Street, Suite 5-2168, Chicago, IL 60611; e-mail: mpatricklowe@mac.com.

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It has been almost 16 years since Childers et al[1,2] reported on 59 patients who underwent laparoscopic-assisted surgical staging for the treatment of endometrial cancer, concluding for the first time that laparoscopy was an alternative to traditional surgery for this disease. Since that initial publication, several articles on laparoscopy to treat endometrial cancer have been reported, and in 2005, Magrina[3] summarized these data and concluded that an open approach is an alternative to laparoscopy for early endometrial cancer. However, in that same year, a survey of members of the Society of Gynecologic Oncologists revealed that only 8% of gynecologic oncologists used laparoscopy to treat more than one half of their patients with endometrial cancer, highlighting the underuse of laparoscopy in this subspecialty despite its benefits.[4] Shortly thereafter, in April 2005, the U.S. Food and Drug Administration approved the da Vinci Surgical System (Intuitive Surgical, Inc., Sunnyvale, CA) for use in gynecology and gynecologic oncology, ushering in a potentially new era of minimally invasive surgery for women with benign and malignant gynecologic disorders. Since that time, a small number of investigators have reported their initial outcomes on robotic surgery for the treatment of endometrial cancer. Although these initial results have been very promising, the data have been limited to single surgeon or single institution experiences.[5–14] To date, no multiinstitutional or randomized controlled trials on robotic surgery for the treatment of gynecologic malignancies has been reported.

The da Vinci Surgical System is a robotic surgical platform that has applications in many surgical specialties (urology, general surgery, cardiovascular surgery, and gynecologic surgery). The advantages of the robotic surgical platform for gynecologic surgery have been previously reported by several authors.[5–14] These advantages potentially make it the ideal tool for performing complex oncologic procedures such as endometrial cancer staging that require delicate dissection (retroperitoneum, pelvic, and aortic node dissection) while maintaining the principles of oncologic surgery but in a minimally invasive fashion. In this article, we report perioperative outcomes and learning curve characteristics from a multiinstitutional experience with robotic-assisted surgical staging for endometrial cancer.

MATERIALS AND METHODS

A multiinstitutional robotic surgical consortium consisting of five board-certified gynecologist oncologists in distinct geographic regions of the United States was created to evaluate the usefulness of robotics for gynecologic surgery (benign and malignant). Regions of the United States represented included the Southeast, the Midsouth, and the Midwest. Between April 2003 and January 2009, a total of 959 patients underwent robotic surgery for benign gynecologic disorders or gynecologic malignancies by a surgeon in the research consortium. Institutional review board approval was obtained, and data were collected at each institution. For the purposes of the consortium, a multiinstitutional database in compliance with the Health Insurance Portability and Accountability Act of 1996 was then created for all patients who underwent robotic-assisted surgery between the April 2003 and January 2009. This database was retrospectively queried for all patients who underwent robotic-assisted surgical staging for endometrial cancer. Four hundred five patients were identified. Records were then reviewed for demographic data, medical conditions, prior abdominal or pelvic surgeries, and follow-up. The perioperative outcomes analyzed included operative time (skin–skin), estimated blood loss (EBL), length of hospital stay, total lymph node count, conversion to laparotomy, and operative complications.

Patients were selected for robotic surgery at the discretion of each surgeon, but limitations of patients eligible for robotic surgery included multiple prior abdominal surgeries with documented history of extensive abdominopelvic adhesions, evidence of disease outside the uterus, and large uterine size. Obesity was not considered as a contraindication for robotic surgery. Conversion to laparotomy was analyzed on an intent-to-treat basis. This was defined as any exploratory laparotomy required to complete the planned robotic hysterectomy and staging procedures (pelvic or aortic node dissection). This also included unsuccessful attempts at lysis of adhesions laparoscopically before docking of the robot. This did not include minilaparotomy for organ removal if the entire procedure was otherwise performed robotically. The decision to perform a lymph node dissection based on intraoperative findings rather than performing a full pelvic and paraaortic lymph node dissection on all patients with endometrial cancer was at the discretion of the surgeon, because some practice patterns varied. Thus in some patients, the surgeon omitted a lymph node dissection based on intraoperative findings or medical comorbidities.

Individual surgeon outcomes were analyzed as well in an attempt to evaluate characteristics of learning and incorporation of robotic technology. Surgeons were ranked from the most to least number of robotic surgeries performed to compare trends in outcomes. The least number of robotic surgeries for endometrial cancer by a member of the research consortium was 41 and the most was 119. Individual surgeon outcomes analyzed included operative time, estimated blood loss, nodal count, conversion to laparotomy, hospital stay, and intraoperative complications. To further evaluate the learning curve, the group mean blood loss and operative time were compared with the individual surgeon's first chronological case that was within one standard deviation of the group mean for these measures. Once this chronological case was identified, the surgeon was required to duplicate this feat for five consecutive endometrial cancer staging surgeries to demonstrate reproducibility and attainment of proficiency with the procedure. This procedure enabled us to define the average number of cases that might be required until a surgeon attains proficiency (which we defined as being able to maintain five consecutive cases within the group mean plus or minus one standard deviation). Because the average number of cases that caused learning based on the measures was known now, we decided to do a repeated measures analysis of variance on ranks of each surgeon's successive cases that differ by that average to evaluate any statistically significant learning effect.

All members of the research consortium were among early adopters of robotic technology for use in gynecologic surgical applications in their respective regions of the country. For credentialing and training purposes, surgeons completed an online training course, a 1–2-day porcine surgical laboratory, case observations, and individual case proctoring (2–5 cases per surgeon) before receiving robotic surgical privileges at their respective institutions. The length of robotic surgical experience for all surgeons in the consortium ranged from 3–5 years for all surgeons at the time of data analysis. Prior experience with advanced laparoscopy also varied among the surgeons from no prior experience reported by one surgeon to another having served as a postgraduate instructor on advanced laparoscopy at Society for Gynecologic Oncologists annual meetings. All surgeons were well-versed in the technique of traditional surgery for endometrial cancer staging. Practice patterns varied among the members from private practice to university-affiliated private practice to university-affiliated academic practice. All endometrial cancer staging surgeries hysterectomies for were performed with either the da Vinci S or da Vinci Standard Surgical System.

For the statistical analysis we used Kruskal-Wallis one-way analysis of variance on ranks, which was performed on individual surgeon outcomes, followed by Dunn's pair-wise multiple comparison procedure to isolate group(s) that statistically differ from the other groups.

RESULTS

From a database of 959 patients who underwent robotic surgery for gynecologic diseases (benign and malignant), a total of 405 patients were identified who underwent a robotic-assisted hysterectomy with staging for endometrial cancer. With regard to patient demographics, the mean age was 62.2 years. The mean body mass index was 32.4 The majority of the patients were white (90%). African American and Indian accounted for 7.73% and 1.36% of patients, respectively. The remaining patients were Hispanic. Medical comorbidities such as hypertension (62.6%) and diabetes mellitus (25.4%) were prevalent among the study group. More than one half (55%) of the patients reported a prior abdominal surgery. Three fourths (78%) of the patients had at least one of these comorbidities. Final pathologic analysis demonstrated that stage I and II disease comprised 82.8% and 6.8% of patients, respectively. Stage III disease accounted for 6.8% of the patients. No patients with Stage IV disease were identified. A total of 97% of all patients had staging information available for analysis.

With regard to operative findings (Table 1), the mean operative time was 170.5 minutes. The mean estimated blood loss was 87.5 mL. The mean lymph node count was 15.5. Overall, 91.6% of all patients underwent at least a pelvic node dissection, and 72% underwent a pelvic and aortic lymph node dissection. The mean hospital stay was 1.8 days. Conversion from robotics to an open approach occurred in 6.7% of patients. The most common reason for conversion was associated with endometrial cancer staging (grossly involved adnexal or nodal disease, 1.5%) or uterine size greater than anticipated (2.5%). Conversion due to an inability to ventilate the patient (rising CO_2 or crepitus) occurred in only 1.5% of patients. Intraoperative complications were uncommon and occurred in only 3.5% of the patients. Intraoperative vascular injuries were rare, occurring in 1.2% of patients (Table 2). All were venous in nature and occurred during lymph node dissection. The most common venous injury was to the external iliac vein. All venous injuries were controlled with pressure, vascular clips, or FloSeal (Baxter Healthcare, Deerfield, IL) and did not require conversion to laparotomy. Postoperative complications occurred in 14.6% of

Table 1. Overall Operative Findings (N=405)

	Mean±SD	SEM	Confidence Interval	Median	Range	25%	75%
Operative time	170.5±68.9	3.5	6.9	172.0	571.0	119.3	209.8
Blood loss	87.5±97.4	4.9	9.6	50.0	795.0	25.0	100.0
Hospital stay	1.8±2.8	0.1	0.3	1.0	29.8	1.0	2.0
Node count	15.5±9.6	0.5	1.0	15.0	69.0	9.0	21.0
Pelvic node count	12.7±8.4	0.5	0.9	12.0	59.0	7.0	18.0
Paraaortic node count	2.8±3.1	0.2	0.4	2.0	16.0	0.0	5.0

SD, standard deviation; SEM, standard error of the mean.

Table 2. Intraoperative Complications

Complication	n=14 (3.5%)
Vascular injury	5
Bowel injury	4
Cystotomy	3
Trocar injury	1
Pneumothorax	1
Ureteral injury	0
Rate convert to open (%)	6.7
Uterine size	10
Staging (metastasis)	6
Bowel adhesions	4
Inability to ventilate	4
Pelvic adhesions	3
Hemorrhage	0

Data are n except where otherwise indicated.

the patients with urinary tract infection (1.7%), deep vein thrombosis or pulmonary embolism (1.7%), pelvic abscess (1.5%), wound seroma (1.7%), lymphedema (1.2%), and postoperative fever (2.5%) reported as most common. There were two postoperative deaths (0.5%) reported in the database (Table 3). The first patient presented 3 days after surgery and 2 days after discharge from the hospital, arriving at the emergency room with abdominal pain, nausea, and vomiting. A moderate amount of ascites was noted, as well as leakage from the right external iliac artery (suspected delayed thermal injury) on imaging. A vascular stent was successfully placed. However, within 24 hours the patient's condition worsened, resulting in death from cardiopulmonary arrest. The second patient postoperatively experienced the acute onset of shortness of breath, dizziness with ambulation, and abnormal EKG changes. The patient experienced sudden loss of consciousness with cardiac arrest and could not be resuscitated.

Table 3. Postoperative Complications

Complication	n=59 (14.6%)
Fever	10
Urinary tract infection	7
Venous thromboembolism	7
Wound seroma	7
Abscess	6
Lymphedema/lymphocyst	5
Vaginal cuff bleed	3
Vaginal cuff separation	3
Ileus	3
Vesicovaginal fistula	2
Death	2
Vascular injury	1
Acute renal failure	1
Retroperitoneal bleed	1
Superficial thrombosis	1
Pneumonia	0

Individual surgeon outcomes were also analyzed for perioperative outcomes and total number of robotic surgeries. Tables 4 and 5 detail the perioperative outcomes of each surgeon with regard to operative time, blood loss, nodal yield, conversion to laparotomy, hospital stay, and intraoperative complications. In general, perioperative outcomes were similar among surgeons for estimated blood loss (range 41.3–181.1 mL), nodal yield (8.6–19.2), conversion to laparotomy (3.0–12.2%), hospital stay (range 1.02–4.3 days), and intraoperative complications (range 1.1–4.8%). The differences in the median values of operative time among the surgeons is greater than would be expected by chance; there is a statistically significant difference ($P<.001$). To isolate the group or groups that differ from the others we used a multiple comparison procedure (Dunn's method) and found that at least two surgeons were significantly different from the others ($P<.05$). There did not seem to be an association with improved perioperative outcomes based on prior laparoscopic surgical experience (Surgeon A compared with Surgeon C) (Table 4).

To further evaluate characteristics of learning, the group mean blood loss and operative time were compared with the individual surgeon's first chronological case that was within one standard deviation of the group mean for these measures. Once this chronological case was identified, the surgeon was required to duplicate this feat for five consecutive endometrial cancer staging surgeries to demonstrate proficiency. The learning curve for each surgeon and the group was calculated and is shown in Table 6.

Four of the five surgeons reached the group mean estimated blood loss within their first five surgeries. Three of the five surgeons reached the group mean operative time within their first five surgeries. It should be noted in Table 6, surgeons A and B learned robotics together, surgeon C alone, and surgeons D and E learned robotics together. Thus, it seems that robotic proficiency can be achieved alone or with a surgical partner with similar outcomes.

DISCUSSION

The concept of minimally invasive surgery for gynecologic malignancies, such as endometrial and cervical cancer, has gone from a perceived near impossibility to a fully recognized option for many patients over the past 5–10 years.[15] The goal of minimally invasive surgery is to duplicate tradi-

Table 4. Summary of Operative Outcomes by Surgeon

Surgeon (n cases)	Median OR Time (min)	Median EBL (mL)	Lymph Nodes (Mean±SD)	CTL (%)	Hospital Stay (d)	Intraoperative Complication (%)
A* (n=119)	115.2	41.3		3.4	1.1	3.4
Total			16.7±11.1			
Pelvic			14.1±9.6			
Aortic			2.2±3.1			
B (n=105)	208.5	93.2		10.5	1.8	4.7
Total			15.1±8.6			
Pelvic			14.4±8.0			
Aortic			3.1±2.7			
C† (n=91)	173.8	63.7		3.0	1.02	1.1
Total			15.5±9.0			
Pelvic			12.5±7.4			
Aortic			3.3±3.6			
D (n=49)	202.1	181.1		8.2	4.3	4.0
Total			19.2±8.6			
Pelvic			13.8±6.8			
Aortic			4.1±2.8			
E (n=41)	182.9	140		12.2	1.8	4.8
Total			8.6±6.0			
Pelvic			6.4±4.7			
Aortic			2.3±2.2			

OR, operating room; EBL, estimated blood loss; CTL, conversion to laparotomy.
* No prior advanced laparoscopic experience.
† Society for Gynecologic Oncologists laparoscopy instructor.

tional open procedures with several small incisions in the skin, with surgical outcomes equivalent or superior to a traditional surgical approach. Despite its benefits, a laparoscopic approach has not been widely used to treat endometrial cancer by the majority of gynecologic oncologists in the United States.[4] Recently, robotic surgery has become an option in the definitive surgical management of early stage endometrial cancer.[5–12]

The data in this multiinstitutional study were collected from the onset of each author's robotic program. It contains all robotic procedures performed by the authors to date. The strength of our study is that it allows for analysis and evaluation of data from multiple institutions with surgeons of various levels of experience and expertise with robotic surgery. Finally, each author had performed more than 50 robotic surgeries at the time of data analysis, providing an opportunity to evaluate characteristics of learning. The weakness of our study is in its retrospective nature and the lack of a comparison group.

A review by Magrina[3] of the literature on laparoscopic hysterectomy with staging for endometrial cancer demonstrated that the procedure is also safe and feasible, but is associated with an operative time range of 143–237 minutes, an estimated blood loss of 125–350 mL, a nodal yield ranging from 6.8–34, a hospital stay ranging from 2–4.7 days, and an overall complication rate of 0–25% (Boike G, Lurain J, Burke J. A comparison of laparoscopic management of endometrial cancer with traditional laparotomy [abstract]. Gynecol Oncol 1994;52:105).[1–3,16–21] The data reviewed by Magrina compare favorably to the data presented in this study, but with a longer hospital stay and greater blood loss. A review of the interim results of the Lap-2 trial (a randomized control trial comparing laparoscopy to laparotomy for the treatment of endometrial cancer) laparoscopy arm demonstrated an operative time of 203 minutes, a 23% conversion rate to open, and a hospital stay approaching 3 days, with intraoperative and postoperative complications reported in 9.5% and 22% of patients, respectively (Walker J, Peidmont M, Spirtos N, Eisenkop S, Schlaerth J, Mannel R, et al. Surgical staging of uterine cancer: randomized phase III trial of laparoscopy compared with laparotomy–a Gynecologic Oncology Group Study [GOG]: preliminary results [abstract]. Proceedings of the 2006 Annual Meeting of the American Society of Clinical Oncology, Atlanta, Georgia June 2–6, 2006). When compared with the data in our series, robotic surgery seems at least equivalent if not superior to laparoscopy in several perioperative outcomes. Other investigators have also observed this conclusion in direct comparisons.[8–9,12] When compared with traditional open surgery for endometrial cancer, a robotic surgical approach has

Table 5. Statistical Analysis of Individual Surgeon Outcomes

Surgeon (n cases)	Operative Time (min)	EBL (mL)	Hospital Stay (d)	Age (y)	BMI (kg/m²)
Surgeon A* (n=119)					
Mean±SD	115.2±75.2	41.3±65.3	1.1±0.5	62.7±13.2	33.3±9.1
SEM	7.0	6.0	0.05	1.2	0.8
CI of mean	13.8	11.9	0.1	2.4	1.7
Median (range)	92.0 (606.0)	22.5 (500.0)	1.0 (4.0)	62.0 (72.0)	31.8 (35.9)
25th %	76.8	10.0	1.0	56.0	25.3
75th %	125.0	50.0	1.0	72.0	40.6
Surgeon B (n=105)					
Mean±SD	208.5±53.5	93.2±87.5	1.8±2.1	61.5±9.5	33.5±8.3
SEM	5.2	8.6	0.2	0.9	0.8
CI of mean	10.4	17.0	0.4	1.8	1.6
Median (range)	206.0 (250.0)	50.0 (490.0)	1.0 (17.0)	61.0 (52.0)	34.0 (39.0)
25th %	178.8	25.0	1.0	55.8	26.1
75th %	241.5	100.0	0.4	1.8	1.6
Surgeon C† (n=91)					
Mean±SD	173.8±36.6	63.7±46.7	1.022±0.15	60.4±10.7	31.9±8.5
SEM	3.9	4.9	0.02	1.1	0.9
CI of Mean	7.8	9.8	0.03	2.2	1.8
Median (range)	173.0 (205.0)	50.0 (200.0)	1.0 (1.0)	61.0 (53.0)	30.0 (39.0)
25th %	150.0	25.0	1.0	55.0	26.0
75th %	190.0	75.0	1.0	66.0	37.0
Surgeon D (n=49)					
Mean±SD	202.1±61.0	181.1±135.2	4.3±6.7	65.2±12.7	33.7±10.7
SEM	9.3	19.3	1.0	1.8	1.6
CI of mean	18.8	38.8	1.9	3.7	3.3
Median (range)	196.0 (289.0)	200.0 (780.0)	2.0 (29.0)	64.0 (50.0)	29.4 (41.7)
25th %	168.5	100.0	1.75	56.8	26.5
75th %	238.0	200.0	3.0	74.3	40.0
Surgeon E (n=41)					
Mean±SD	182.9±55.4	140.1±122.0	1.8±1.6	62.0±10.5	27.1±8.0
SEM	8.7	19.1	0.3	1.6	1.3
CI of mean	17.5	38.5	0.5	3.3	2.5
Median (range)	167.0 (232.0)	100.0 (550.0)	1.0 (8.0)	63.0 (44.0)	26.0 (36.0)
25th %	150.0	57.5	0.8	56.0	21.8
75th %	200.5	162.5	2.0	70.0	30.1

EBL, estimated blood loss; BMI, body mass index; SD, standard deviation; SEM, standard error of the mean; CI, confidence interval.
* No prior advanced laparoscopic experience.
† Society for Gynecologic Oncologists laparoscopy instructor.

demonstrated an improvement in perioperative outcomes with the exception of operative time.[8–10,12] A summary of perioperative outcomes for robotic surgical management of endometrial cancer is shown in Table 7. Although these articles primarily represent single institution or single surgeon experiences, the data are very promising and would suggest that a robotic approach is preferable to an open approach and possibly a laparoscopic approach.

As with any new surgical technology the learning curve and cost are of paramount concerns. To date, four articles (including this one) have reported on various learning curves for robotic hysterectomy for benign and malignant gynecologic disease.[11,13,22] There are two articles that report the learning curve for hysterectomy with pelvic–paraaortic node dissection for endometrial cancer staging. In the Ohio State experience reported by Seamon et al,[11] the number of cases to gain proficiency was reported as approximately 20 cases. In our study, we chose to determine the group mean operative time and blood loss for all cases and then defined the learning curve as the individual surgeon's first chronological case that was within one standard deviation of the group mean for these measures that was then duplicated for five consecutive endometrial cancer staging surgeries. This process confirmed reproducibility and attainment of proficiency, which in our study were nine cases for operative time and four cases for estimated blood loss. Thus, it is likely that the learning curve for robotic hysterectomy with pelvic and aortic node dissection lies between nine and 20 cases. With regard to costs, there has been one article to date comparing robotic, open, and laparoscopic procedures to surgi-

Table 6. Learning Curve Comparison of da Vinci Hysterectomy Plus Staging for Group Mean Estimated Blood Loss and Operative Time Compared With the Individual Physician's First Chronological Case That Was Within 1 Standard Deviation of the Group Mean and Maintained for the Following Five Cases

Physician (n=DHS)	DHS no. of Cases to Reach Group Mean EBL (96±111)	DHS no. of Cases to Reach Group Mean Operative Time(170±71)
A* (n=91)	1	1
B (n=41)	4	1
C† (n=119)	1	5
D (n=105)	2	19
E (n=49)	10	17
Total (n=405)	4	9

DHS, da Vinci hysterectomy plus staging; EBL, estimated blood loss.
* No prior advanced laparoscopic experience.
† Society for Gynecologic Oncologists laparoscopy instructor.

cally stage endometrial cancer. In that report, the cost of the robotic system was included in the cost analysis for robotic surgery. The total average cost (in U.S. dollars) for hysterectomy with staging for endometrial cancer was reported as follows: open $12,943.60, laparoscopic $7569.80, and robotic $8212.00. Interestingly, there was no statistically significant difference in costs between robotic and laparoscopic approach (P=.06). Both minimally invasive approaches cost significantly less than an open approach (P=.001). However, robotics was associated with less perioperative morbidity and quicker return to normal activity.[9]

One unique aspect of our experience with robotic surgery for endometrial cancer is the varying degrees of prior laparoscopic experience among our surgeons before they adopted robotics into their practices. This experience ranged from the novice (no prior advanced laparoscopic experience) to the expert (Society for Gynecologic Oncologists instructor on advanced laparoscopic techniques). Interestingly, our data from this study suggest that robotic technology may level the playing field between the novice and expert minimally invasive surgeon when applied to complex operations such as endometrial cancer staging. We have identified and reported similar findings for robotic-assisted radical hysterectomy for early stage cervical cancer.[23] This conclusion is supported by the fact that several perioperative outcomes were similar among the individual surgeons irrespective of total number of robotic surgeries performed, with the exception of operative time (Table 4). This conclusion is further supported by the learning characteristics recorded during our analysis of individual surgeon outcomes as compared with overall group means for operative time and blood loss. We found no difference in the attainment of proficiency of robotic technology between the novice and expert laparoscopist (Table 6). Based on these data, the authors feel confident that a strong background in laparoscopy is not a requirement to becoming a successful robotic surgeon. A more detailed learning curve analysis will be presented in a separate article (Table 5).

In conclusion, the data reported in this large, multiinstitutional study further defines the literature on robotic surgery for endometrial cancer and establishes its role as a surgical option for the treatment of endometrial cancer. Robotics has the potential to dramatically expand the minimally invasive surgical option for women undergoing surgery for endometrial cancer. Although improved perioperative outcomes have been associated with a robotic approach to treat endometrial cancer, long-term follow-up data are not available regarding recurrence rates and overall survival.[5–12] These data will be critical and necessary to fully define the role of robotics to treat endometrial or cervical cancers. Although robotics represents a technologic leap over traditional laparoscopy and offers the potential to redefine how gynecologic oncologists consider surgical options for their

Table 7. Perioperative Outcomes for Robotic Surgical Management of Endometrial Cancer

	n	Age (y)	BMI	OP Time (min)	EBL (mL)	LOS (d)	CTL (%)	LN (n)	Intraoperative Complications (%)	Postoperative Complications (%)
Current study	405	62.2	32.4	170.5	87.5	1.8	6.7	15.5	3.5	14.6
Seamon et al[11]	105	59	34	262	99	1	12.4	29	–	–
Boggess et al[8]	103	62	32	191	75	1.0	3.0	32.9	1.0	10
Hoekstra et al[12]	32	62	29	195	50	1.0	3.1	17	6.2	12.5
Denardis et al[10]	56	59	29	177	105	1.0	5.4	19	3.6	16.1
Bell et al[9]	40	63	33	184	166	2.3	–	17	0	7.5
Veljovich et al[7]	25	53	26.3	283	67	1.7	NA	17.5	–	–

BMI, body mass index; OP, operative; EBL, estimated blood loss; LOS, length of stay; CTL, conversion to laparotomy; LN, lymph nodes.

patients with endometrial cancer, further study in a prospective fashion should be performed.

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