

# Robotic-Assisted Hysterectomy for the Management of Severe Endometriosis: A Retrospective Review of Short-Term Surgical Outcomes

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## ABSTRACT

**Objectives:** The primary objective was to examine the safety and feasibility of robotic-assisted laparoscopy in a cohort of women treated surgically for stage III and IV endometriosis. The secondary objective was to explore whether the stage of endometriosis affected surgical outcome.

**Methods:** In this cohort study, 43 women with severe endometriosis were treated with robot-assisted laparoscopic hysterectomy with unilateral or bilateral salpingo-oophorectomy for stage III (n = 19) or stage IV (n = 24) disease.

**Results:** Histopathologic evaluation confirmed endometriosis in all patients, and fibroids were also shown in 12 patients. The median actual operative time was 145 min (range, 67–325 min), and the median blood loss was 100 mL (range, 20–400 mL). All but one of the procedures were completed successfully robotically. The length of hospital stay was 1 d for 95% of patients (41 of 43), and 2 patients had prolonged stays of 4 d and 5 d, respectively. One patient was readmitted for a vaginal cuff abscess; this represented the only complication identified in this series.

**Conclusions:** Robot-assisted laparoscopic surgery appears to be a reasonably safe and feasible method for the definitive surgical management of women with severe endometriosis.

**Key Words:** Robotics, Endometriosis, Surgery.

## INTRODUCTION

Endometriosis is estimated to occur in 6% to 10% of women of reproductive age,<sup>1</sup> with a prevalence of 38% (range, 20%–50%) in infertile women,<sup>2</sup> and in 71% to 87% of women with chronic pelvic pain.<sup>3</sup> In the past, symptomatic moderate to severe endometriosis was most commonly treated by laparotomy with the removal of affected tissue, with or without hysterectomy and bilateral salpingo-oophorectomy. More recently, many women with advanced endometriosis have been treated with a laparoscopic approach because it results in a shorter hospital stay and recovery period compared with laparotomy. However, conventional laparoscopy has inherent limitations for the treatment of advanced endometriosis because of the adhesive nature of the disease, obliteration of the surgical plans, variability of surgical skill levels, and normal mechanics of the human hand.

The use of a robotic system to assist with laparoscopy has been shown to overcome some of the technical limitations of laparoscopy while maintaining its minimally invasive nature. The most widely used system for robotically assisted laparoscopy is the da Vinci Surgical System (Intuitive Surgical, Sunnyvale, CA, USA). Advantages of this system include a steady 3-dimensional (3D) image and articulating instrumentation that allow for 7 degrees of movement, mimicking the human wrist. It also filters the surgeon's hand tremors at the console and eliminates the fulcrum effect encountered in conventional laparoscopy. Moreover, it allows movement downscaling, increasing accuracy and precision. To date, only a small study has been published that examines the feasibility of robotically assisted laparoscopy for the management of advanced endometriosis.<sup>4</sup> The primary objective of this study is to report our experience with the safety and feasibility of robotic surgical treatment of advanced pelvic endometriosis. The secondary objective was to explore whether the stage of endometriosis affected surgical outcome.

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## MATERIALS AND METHODS

The institutional review board of the University Hospitals Case Medical Center, Cleveland, Ohio, approved this retrospective chart review study. Our series consists of 43 patients who underwent robotically assisted laparoscopic surgery for the treatment of advanced endometriosis between April 2008 and March 2010. All data were collected directly from the patients' charts by use of a standardized data collection sheet. The electronic records of 422 patients who underwent robotic surgery during the study period for gynecologic indications were evaluated. Patients with histologically confirmed endometriosis were identified. Operative reports of this cohort were reviewed. The extent of disease as dictated by the primary surgeon was matched against the American Society for Reproductive Medicine (ASRM) classification of endometriosis for staging.<sup>5</sup> Patients with stage I and II endometriosis were excluded (n = 11). Patients who underwent conservative surgical management with uterine preservation were also excluded (n = 7). There were no selection criteria to use the robotic platform. This was based solely on surgeon preference, scheduling, and availability.

Demographic and clinical characteristics were recorded, and the patients were divided into 2 groups according to the ASRM classification by endometriosis stage III or IV.<sup>5</sup> Outcome variables included total operating room, actual operative time, and postanesthesia care unit (PACU) time (in minutes); estimated blood loss (in milliliters); and uterine weight (in grams). Complications were determined by examination of the hospital chart and the postoperative visit notes within 6 mo after surgery.

### Operative Technique

After induction of general anesthesia, the patient was positioned in the dorsal lithotomy position with both arms tucked by the patient's side. A beanbag was adjusted to keep the arms and the shoulders in place. Pneumoperitoneum was usually induced with a Veress needle. A 12-mm trocar was placed 2 to 5 cm supraumbilically. Two 8-mm robotic trocars were placed bilaterally, 10 cm lateral to and at the level of the umbilicus. An accessory 10-mm trocar was placed in the left lower quadrant. Monopolar scissors were inserted through the right robotic trocar, and a plasma kinetic dissecting forceps was inserted through the left robotic trocar.

Oophorectomy was started by entering the retroperitoneal space of the lateral pelvic sidewall with unipolar electro-surgery. The infundibulopelvic (IP) ligament was then

skeletonized. The ureter was identified. Subsequently, unipolar electro-surgery was used to create a window below the IP ligament and above the ureter. The IP was then coagulated 3 times and divided. Alternatively, the IP was coagulated and cut if the ureter could be visualized easily. This process was repeated on the contralateral side when both ovaries were removed. Lysis of adhesions was then performed to restore normal anatomy in patients with extensive adhesions.

Unilateral lateral pelvic sidewall dissection and ureterolysis were performed in a total of 8 patients (3 with stage III and 5 with stage IV disease) to resect deep infiltrating lesions. Partial obliteration of the cul-de-sac was treated with sharp dissection in only 3 patients with stage IV disease. Careful dissection with and without the use of electrocautery was used to preserve the integrity of the ureter, pelvic vessels, and rectum. The hysterectomy portion of the procedure was then completed by a standard approach according to the surgeon's preference.

The Foley catheter was removed at the end of the procedure. A regular diet was started on the same day of the operation, and patients were allowed to ambulate as soon as possible. The patient was routinely discharged the morning after surgery, unless the patient's clinical condition required continued hospitalization. A routine postoperative visit was made 4 to 6 wk after the surgery and as needed thereafter. Total operative time was defined as the time elapsed from intubation to extubation in minutes. Actual operative time was defined as the time elapsed from skin incision to skin closure. The PACU time was defined as the time from arriving to the PACU until discharge of the patient to the floor.

### Statistical Analysis

Patient characteristics and surgical parameters for the entire cohort of patients were described. A secondary goal was to compare these parameters among patients with stage III and stage IV endometriosis. Patient demographic and clinical characteristics were compared between stage III and IV endometriosis patients by use of the Mann-Whitney *U* test for continuous variables and  $\chi^2$  tests for categorical variables. The median total operating room, actual operative, and PACU times were compared for women with stage III and IV endometriosis by use of the Mann-Whitney *U* test. *P* < .05 was considered statistically significant. Data were analyzed with SPSS software, version 17.0 (SPSS, Chicago, IL, USA).

## RESULTS

### Patient Characteristics

Forty-three women underwent a robotic procedure for advanced endometriosis (**Table 1**). Of these, 19 (44.2%) had stage III and 24 (55.8%) had stage IV endometriosis. The median patient age was 46 y (range, 32–68 y), and the mean body mass index was 28 kg/m<sup>2</sup> (range, 20.2–50.2 kg/m<sup>2</sup>). Baseline characteristics were similar in both groups.

Nine patients (20.9%) had previously undergone laparotomy for various indications. Along with the hysterectomy, both ovaries were removed in 29 of 43 patients (67.5%). In 14 patients (32.5%), only 1 ovary was removed and the contralateral ovary was preserved.

### Intraoperative Outcomes

The median total operative time was 190 min (range, 97–368 min), including patient positioning, robot docking, performing surgery, and performing closure of the port sites. The median actual operative time was 145 min (range, 67–325 min), and both total operating room time and actual operative time were comparable between the 2 groups (**Table 1**). There was no difference between the 2

groups regarding estimated blood loss and uterine weight. Pathologic evaluation confirmed the endometriosis diagnosis in all patients. There was 1 conversion to laparotomy because of the size and location of multiple fibroids in a woman with a 14 wk-sized uterus. One patient also required vaginal assistance to expedite completion of her hysterectomy.

### Postoperative Outcomes

There was no significant difference between groups in PACU times, with a median of 80 min (range, 32–165 min) for all patients. Narcotics were given postoperatively as needed. All patients were sent home with oral oxycodone/acetaminophene, 5/325 mg. Histopathologic confirmation of the disease was established postoperatively. Concomitant fibroids were confirmed in 12 patients (27.9%). Almost all patients were discharged the day after surgery (41 of 43 [95%]); 1 patient who was converted to laparotomy was discharged after 5 d, and another patient stayed for 3 d because of postoperative ileus that resolved spontaneously. One patient was readmitted on postoperative day 11 with fever, chills, and lower abdominal pain. Computed tomography showed a vaginal cuff abscess. She was treated with antibiotics, the abscess was drained vaginally under general anesthesia, and a Foley catheter was

**Table 1.**  
Baseline Characteristics and Intraoperative Outcome Measures of Study Population

Patient/Clinical Demographics	Overall (N = 43)	Stage III Endometriosis (n = 19)	Stage IV Endometriosis (n = 24)	P Value <sup>a</sup>
Age [median (range)] (y)	46 (32–68)	49 (34–68)	43.5 (32–61)	.339
BMI <sup>b</sup> [mean (SD)] (kg/m <sup>2</sup> )	28 (20.2–50.2)	26.8 (21.3–45.4)	30.4 (20.2–50.2)	.695
Previous surgery	9 (20.9%)	3 (15.8%)	6 (25%)	.708
Total OR <sup>b</sup> time [median (range)] (min)	190 (97–368)	190 (97–290)	183 (138–368)	.934
Actual operative time [median (range)] (min)	145 (67–325)	145 (67–234)	146.5 (102–325)	.882
Uterine weight [median (range)] (g)	121.3 (48–570)	105 (52–376)	125.1 (48–570)	.839
EBL <sup>b</sup> [median (range)] (mL)	100 (20–400)	100 (25–325)	100 (20–400)	.503
Complications intraoperatively	2 (4%)	1 (5.2%)	1 (4.2%)	.999
PACU time [median (range)] (min)	80 (32–165)	87.5 (32–135)	80.0 (32–165)	.752
Hospital stay				
1 d	41 (95.3%)	19 (100%)	22 (91.7%)	.495
>1 d	2 (4.7%)	0	2 (8.3%)	
Complications postoperatively	1 (2%)	0	1 (4.2%)	.999

<sup>a</sup>Comparison of stage III and stage IV endometriosis with Mann-Whitney *U* or  $\chi^2$  test.

<sup>b</sup>BMI = body mass index; EBL = estimated blood loss; OR = operating room.

placed into the abscess cavity. She remained afebrile and was discharged after 4 d. The Foley catheter was removed after 7 d.

## DISCUSSION

Our study represents the largest cohort of patients with advanced endometriosis managed with definitive surgery by robotic laparoscopy reported in the literature. In this study of 43 patients with stage III and IV endometriosis, intraoperative complication rates were low and only 1 patient required conversion to laparotomy. Moreover, only 1 minor and 1 major postoperative complication occurred, manifesting as a self-limited ileus and a vaginal cuff abscess, respectively. Together these data suggest both the feasibility and safety of this surgical modality for the definitive treatment of severe endometriosis.

There are very few randomized trials evaluating the different surgical approaches to pelvic endometriosis. Whereas Nezhat et al.<sup>4</sup> observed no benefit of robotic over conventional laparoscopy for the surgical treatment of stage I or II endometriosis, we speculate that such comparisons are unlikely to be equivocal for more severe manifestations of endometriosis. A 10% rate of conversion to laparotomy has been reported in patients with severe endometriosis managed with conventional laparoscopy when performed by high-volume, experienced laparoscopic surgeons.<sup>6</sup> In our series there were no conversions to laparotomy because of an intraoperative complication; moreover, a 2% overall conversion rate (1 of 50) compares favorably with that reported with conventional laparoscopy. Furthermore, as the complexity of pelvic dissection necessary for the surgical management of severe pelvic endometriosis increases, the advantages provided by the robotic platform become more indispensable. Isolated reports have documented its use in patients with severe endometriosis involving the urinary and gastrointestinal systems.<sup>7,8</sup> These reports encourage further exploration of robotic surgery in this population of patients.

Among its inherent characteristics, the 3D technology of robotic surgery is of particular importance in the surgical management of severe endometriosis. The robotic platform improves the depth of perception and facilitates the resection of deep infiltrating lesions. In addition, the robotic system improves dexterity, filters the surgeon's tremor, and improves intuitive movements.<sup>9,10</sup> These features enable the surgeon to execute complicated surgical steps such as re-creation of an obliterated cul-de-sac, lateral pelvic wall dissection and resection of densely adherent endometriomas, ureterolysis, and enterolysis.

Moreover, the 7 *df* and 3D visual image permit easier handling of the tissue.<sup>10,11</sup>

Robotic surgery has several disadvantages compared with traditional laparotomy. These include increased cost; the lack of tactile feedback to the surgeon; the presence of bulky robotic arms, as well as long and thick cords; the inability to move the surgical table once the robot arms are attached; and a limited range of motion with respect to operating in different quadrants in the same case.<sup>4</sup> A major potential limitation of robotic surgery is the absence of tactile (also called "haptic") feedback. This is of particular importance when the dissection is close to delicate structures, such as the ureter, blood vessels, and rectum. This could lead to an inability to determine the strength needed for suturing without breaking the suture or possible injury to adjacent structures. It is especially true in early cases performed by inexperienced surgeons, and its effect will decrease but not disappear with experience. In addition, visual cues from the 3D image may dampen this limitation.<sup>12</sup>

This study has several limitations. First, it is a retrospective study and, as such, has inherent weaknesses. Ideally, a prospective randomized trial with laparotomy or laparoscopy without robotic assistance as a control group will be of interest when analyzing the perioperative outcomes. The study is also limited by the lack of a control group. In addition, it is limited by the lack of long-term outcomes including recurrence of endometriosis. Given the fact that the long-term objective of most patients with pelvic pain due to endometriosis is pain relief, a study with the long-term goal of pain relief is needed. However, most our patients were followed up for up to 1 y after surgery without recurrence of symptoms.

The ASRM scoring system did not correlate well with either perioperative or postoperative outcome measures in our cohort of patients. Although the ASRM system's limitations in predicting clinically relevant outcomes in patients with endometriosis, such as pelvic pain and fertility, are well described, the scoring system was developed to describe the extent and location of anatomic distortion in patients with endometriosis. Anatomic findings, such as cul-de-sac obliteration, adhesions to the broad ligament and pelvic sidewall, and deep peritoneal implants, are anticipated to add to the complexity of definitive surgery for endometriosis. We regard our finding that the operative time was not significantly correlated with ASRM stage as a significant negative finding. Although these data may suggest limitations in either the functionality or the reproducibility of the ASRM system (or

both), one may also surmise that these findings further attest to the ability of the robotic technique to manage distorted pelvic anatomy with greater ease. Because of these questions, long-term prospective studies on the definitive surgical management of severe endometriosis are of great interest. However, investigators will also be challenged to prospectively define meaningful and reproducible inclusion criteria for these studies.

## CONCLUSION

In this retrospective cohort of 43 patients with stage III and IV endometriosis, we found robotic-assisted laparoscopy to be both safe and feasible. Moreover, we speculate that the unique features of the robotic platform may offer advantages over conventional laparoscopy in patients with more severe forms of endometriosis and allow more women with this condition the opportunity for surgical management by a minimally invasive approach. A prospective study is essential to more fully evaluate the relative merits of the robotic platform in the surgical treatment of severe endometriosis.

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