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Original Article

Robotic-Assisted Laparoscopy vs Conventional Laparoscopy for the Treatment of Advanced Stage Endometriosis

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ABSTRACT **Study Objective:** To compare robotic-assisted laparoscopy with conventional laparoscopy for treatment of advanced stage endometriosis insofar as operative time, estimated blood loss, complication rate, and length of hospital stay.

Study Design: Retrospective cohort study (Canadian Task Force classification II2). All procedures were performed by one surgeon between January 2004 and July 2012. Data was collected via chart review.

Setting: Tertiary referral center for treatment of endometriosis.

Patients: Four hundred twenty women with advanced endometriosis.

Interventions: Fertility-sparing surgery to treat advanced endometriosis, either via conventional or robotic-assisted laparoscopy.

Measurements and Main Results: Patient demographic data, operative time, estimated blood loss, complication rate, and length of hospital stay were compared between the 2 groups. Two hundred seventy-three patients underwent conventional laparoscopy and 147 patients underwent robotic-assisted laparoscopy for fertility-sparing treatment of advanced stage endometriosis. Patients in both groups had similar characteristics insofar as age, body mass index, and previous abdominal surgeries. There were no significant differences in blood loss or complication rate between the 2 groups. Mean operative time in the conventional laparoscopy group was 135 minutes (range, 115–156 minutes), and in the robotic-assisted laparoscopy group was 196 minutes (range, 185–209 minutes), with a mean difference in operative time of 61 minutes ($p < .001$). Length of hospital stay was also significantly increased in the robotic-assisted laparoscopy group. Most patients who underwent conventional laparoscopy were discharged to home on the day of surgery. Of 273 patients in the conventional laparoscopy group, only 63 remained in the hospital overnight, and all 147 patients in the robotic-assisted laparoscopy group were discharged on postoperative day 1.

Conclusion: Conventional laparoscopy and robotic-assisted laparoscopy are excellent methods for treatment of advanced stages of endometriosis. However, use of the robotic platform may increase operative time and might also be associated with longer hospital stay. Journal of Minimally Invasive Gynecology (2015) 22, 40–44 Published by Elsevier Inc. on behalf of AAGL.

Keywords: Advanced stage endometriosis; Conventional laparoscopy; Robotic-assisted laparoscopy

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Endometriosis is a complex disease that affects 10% to 50% of women of reproductive age worldwide [1,2]. Currently, laparoscopic surgery is considered the gold standard for diagnosis and treatment of endometriosis [1,2]. For advanced endometriosis (stages III and IV), laparoscopic treatment can be technically difficult and is often reserved for use by specialists in laparoscopic techniques [1]. For this reason, many surgeons still perform laparotomy for treatment of advanced stage endometriosis.

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The advent of computer-enhanced technology such as the surgical robot has enabled many surgeons to convert from use of laparotomy to robotic-assisted laparoscopy [3–5]. Several publications have compared conventional laparoscopy with robotic-assisted laparoscopy for common gynecologic procedures such as hysterectomy and myomectomy. The data support robotic-assisted laparoscopy as a feasible approach to minimally invasive surgery for use by surgeons not comfortable with performing conventional laparoscopy [5–17]. However, of those publications, only 3 were randomized controlled trials, and few specifically addressed advanced stage endometriosis [18–24]. The objective of the present study was to evaluate the safety and efficacy of robotic-assisted laparoscopy vs conventional laparoscopy for treatment of advanced stage endometriosis.

Material and Methods

This was a retrospective cohort study of all consecutive patients undergoing fertility-sparing treatment of advanced stage endometriosis from January 2004 to July 2012. Institutional review board approval was not required because of the retrospective nature of the study. Data were collected via review of electronic and paper medical records.

In all patients, the indication for surgery was pain and/or infertility. Patients were included if they had undergone fertility-sparing treatment of endometriosis during the study period. Patients were selected to undergo robotic-assisted laparoscopy or conventional laparoscopy strictly on the basis of availability of the patient on the robot operating room day. No clinical parameters were used to guide the surgical technique. Patients were excluded if they were found to have stage 1 or 2 endometriosis or if they needed bladder, ureteral, or bowel resection (including disk excision) or hysterectomy, myomectomy, or thoracoscopy.

All surgical procedures were performed at a tertiary endometriosis referral center by the same surgeon (C.N.), who has extensive experience with both conventional laparoscopy and robotic-assisted laparoscopy. He was also involved in the original development and testing of the da Vinci robot [25], and thus his experience dates back to the laboratory testing of the da Vinci Surgical System.

For all procedures, the patient was placed in the conventional dorsal lithotomy position with the legs in Allen stirrups. After the abdomen was entered, hysteroscopy and chromopertubation were performed, and a HUMI manipulator (Harris-Kronner Uterine Manipulator Injector; Cooper-Surgical, Inc., Trumbull, CT) was placed in the uterus. Three 5-mm trocars were placed for conventional laparoscopy. For robotic-assisted laparoscopy, one 12-mm trocar, two 8-mm trocars, and one 5-mm assistant trocar were used until 2011, when the 8-mm trocars were replaced by 5-mm robotic ports. Most cases also included cystoscopy and proctoscopy at the end of the surgical procedure to early recognize and treat potential genitourinary and/or gastrointestinal injuries, respectively.

For robotic-assisted laparoscopy, the da Vinci Surgical System (Intuitive Surgical. Inc., Sunnyvale, CA) was initially docked centrally when using the first-generation system, then side docked on the patient's right side when the second- and third-generation da Vinci robots became available. The suprapubic trocar was used as the assistant port, and the operating surgeon controlled 2 robotic arms from the console. Use of the third robotic arm is deemed cumbersome by our group. From experience, not only does it increase the possible risk of torching and blind injury to tissue but it also requires an extra incision.

The instruments used for robotic-assisted treatment of endometriosis included scissors, a monopolar hook, a grasper, a needle holder, and a suction/irrigator probe [26]. For conventional laparoscopy, the instruments included a CO_2 laser or PlasmaJet (Plasma Surgical, Inc., Roswell, GA), a grasper, a bipolar system, a suction/irrigator probe, and a needle holder if needed [26].

Electronic and paper medical records were reviewed to evaluate operative time, estimated blood loss, and intraoperative and postoperative complications. Operative time was calculated on the basis of the anesthesia record of surgery start and end times. This included abdominal entry, placement of trocars, hysteroscopy, docking of the robot, surgeon console time, undocking, cystoscopy, proctoscopy, and closure of trocar sites. Estimated blood loss was calculated by measuring the blood collected in the suction canisters and subtracting the amount of irrigation used during the surgery. Preoperative and postoperative complete blood cell counts were then compared for accuracy. Complications were graded according to the Clavien-Dindo classification of surgical complications [27]. Only important complications classified as grade III to V were recorded.

Comparisons were made between the conventional and robotic-assisted laparoscopy groups using the Mann-Whitney test and *t*-test analysis. A p value $<.05$ was considered statistically significant.

Results

A total of 420 patients underwent conservative treatment of stage III or IV endometriosis during the study period. Of these, 273 patients underwent conventional laparoscopy and 147 underwent robotic-assisted laparoscopy. Five patients in the conventional laparoscopy group were originally scheduled to undergo robotic-assisted laparoscopy. However, the robot was not docked because of the presence of extensive extrapelvic endometriosis. Because the robotic camera is not interchangeable between ports and the arms are not so easily maneuverable in extrapelvic sites, use of the robotic platform would have been time consuming and intricate. Three procedures in the robotic-assisted laparoscopy group were converted to conventional laparoscopy for the same reason. Data for these 3 patients were included in the robotic-assisted laparoscopy analysis because the robotic ports were placed, the da Vinci robot was docked, and a