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Robotic versus standard laparoscopy for the treatment of endometriosis

Camran Nezhat, M.D.,[a] *Michael Lewis, M.D.,*[a] *Sumathi Kotikela, M.D.,*[a] *Arathi Veeraswamy, M.D.,*[a] *Lily Saadat,*[a] *Babak Hajhosseini, M.D.,*[a] *and Ceana Nezhat, M.D.*[b]

[a] Center for Minimally Invasive and Robotic Surgery, Stanford University Medical Center, Palo Alto, California, and [b] Atlanta Center for Minimally Invasive Surgery & Reproductive Medicine, Atlanta, Georgia

Objective: To compare robot assisted laparoscopic platform to standard laparoscopy for the treatment of endometriosis.

Design: A retrospective cohort controlled study.

Setting: Tertiary referral center.

Patient(s): Seventy-eight reproductive aged women.

Intervention(s): Robot assisted or standard laparoscopy for the treatment of endometriosis between January 2008 and January 2009.

Main Outcome Measure(s): Operative time, estimated blood loss, hospitalization time, intraoperative and postoperative complications.

Result(s): Seventy-eight patients underwent treatment of endometriosis, 40 by robot assisted laparoscopy and 38 by standard laparoscopy. The two groups were matched for age, body mass index (BMI), stage of endometriosis, and previous abdominal surgery. Mean operative time with the robot was 191 minutes (range 135–295 minutes) compared with 159 minutes (range 85–320 minutes) during standard laparoscopy. There were no significant differences in blood loss, hospitalization, intraoperative or postoperative complications. There were no conversions to laparotomy.

Conclusion(s): Both robot assisted laparoscopic and standard laparoscopic treatment of endometriosis have excellent outcomes. The robotic technique required significantly longer surgical and anesthesia time, as well as larger trocars. (Fertil Steril® 2010;94:2758–60. ©2010 by American Society for Reproductive Medicine.)

Key Words: Endometriosis, robotic surgery, laparoscopy, robotic-assisted laparoscopy, minimally invasive surgery, keyhole surgery

Endometriosis is a chronic gynecologic disorder that affects more than 70 million women and adolescents worldwide (1). Current guidelines recommend initiating treatment with a trial of nonsteroidal anti-inflammatory agents and hormonal therapy such as oral contraceptives (OC) or gonadotropin agonists. Laparoscopy, also considered the gold standard for diagnosis, is recognized as subsequent management when conservative therapy fails. In the past several decades, laparoscopy, to a large degree, has replaced laparotomy for the treatment of endometriosis (2). At present, gynecologic surgeons have access to a collection of instruments and energy sources, such as scissors, carbon dioxide laser, argon or KTP laser, bipolar or monopolar radiofrequency, ultrasound or plasma energy, for laparoscopic treatment of endometriosis. Since the introduction of computer enhanced technology (robotics) to surgery, attention has focused on its advantages and disadvantages. Robotics have been used successfully in fields other than gynecology, such as urology, cardiology, general surgery, orthopedic surgery, ophthalmology, and neurosurgery, and it is believed to enable more surgeons to convert laparotomies to laparoscopies (3–14). The three-dimensional (3D) visual system in robot assisted surgery allows for improved spectral depth perception and its intuitive movements and articulating instruments allows for greater range of motion and filtration of any natural tremor of the surgeon (14–16). Another advantage of the present robotic platform is the ability of the surgeon to sit, which can avoid surgeon fatigue, especially during long operations.

Utilization of the robot for tubal reanastomosis, myomectomy, and hysterectomy has been previously reported (10–18). This article reflects our experience in the treatment of endometriosis using both standard laparoscopy and robot assisted laparoscopy.

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Reprint requests: Camran Nezhat, M.D., Center for Special Minimally and Robotic Surgery, 900 Welch Road, Suite 403, Palo Alto, CA 94304 (FAX: 650-327-2794; E-mail: cnezhat@standford.edu).

MATERIALS AND METHODS

This retrospective study consisted of 78 patients who underwent laparoscopic surgery for the treatment of endometriosis between January 2008 and January 2009. Forty patients had robot assisted laparoscopy (RAL) and 38 patients had standard laparoscopy (SL). The two groups were matched for age, body mass index (BMI), and stage of endometriosis. All data were collected directly from the patients' chart. There were no selection criteria to use the robotic platform. This was based entirely on scheduling and availability. Institutional Review Board approval was obtained.

For all RAL cases, the da Vinci robotic surgical system (Intuitive Surgical Inc., Sunnyvale, CA) was used. All patients undergoing the RAL procedure were placed in the dorsal lithotomy position and a HUMI uterine manipulator and a Foley catheter were placed. Four ports were inserted: one 12-mm umbilical, two 5-mm midlateral, and one 5-mm or 12-mm suprapubic port. All procedures began

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as standard laparoscopy, with the subsequent integration of the robot into the surgical field (19). The primary surgeon controlled the robot remotely from the console, displaying a high-definition, highly magnified 3D image of the surgical field. The suprapubic port was used by the assistant to provide ancillary laparoscopic instruments as needed by the surgeon. Instruments used during the robotic procedure included a needle holder, a monopolar hook, suction/irrigator, a grasper, and scissors (19). In the SL cases, the equipment used included a vessel-sealing device, a CO_2 laser, a suction/irrigator, a grasper, a Kleppinger bipolar system, and/or PlasmaJet energy system (20).

Statistical Analysis

A retrospective chart review was performed. Main outcome measures included operative time, estimated blood loss, hospitalization time, intraoperative and postoperative complications. Comparisons between the study group and the controls were based on Fisher's exact test, Mann-Whitney test, and exact χ^2 tests.

RESULTS

The mean age was 35 years (range 22–49 years) in the RAL group and 33 years (range 18–46 years) in the SL group. The mean BMI in the RAL group was 24 (range 19–37) and 23 (range 18–31) in the SL group. In the RAL group 18 of 40 patients (45%) has a previous pelvic surgery versus 15 of 38 patients (40%) in the SL group (Table 1). An even distribution of procedures included ovarian cystectomy or salpingoophorectomy, myomectomy, hysterectomy, segmental bowel, bladder and ureter resection. The stage of endometriosis was noted to be evenly distributed among both groups (Table 2).

The mean operative time with the robot was 191 minutes, compared with 159 minutes during standard laparoscopy. Docking the robot averaged 14 minutes (range 10–25 minutes) and included time for troubleshooting. Disassembly averaged 3 minutes (range 2–7 minutes). In our facility, the robotic arms and columns are draped before the start time. There was no statistical difference in blood loss and there were no intraoperative or postoperative complications in either group (Table 3). One of 40 in the RAL group (2.5%) versus 3 of 38 (7.8%) in the SL group achieved pregnancy spontaneously within 4–6 weeks after surgery.

DISCUSSION

Present robotic assisted platform surgery has been a topic of immense interest in the medical community. Since Nezhat's collaborative work with robotic pioneers Ajit Shah and Phil Green from the Stanford Research Institute who developed the Da Vinci robot in the 1990s, others have successfully applied this technology to various fields (3–10,18, 21).

Our study suggests that RAL for the treatment of endometriosis is feasible and does not add any additional morbidity to the procedure using 5-mm ports. However, we were surprised that RAL did not have better outcomes than SL, as we have always believed if you can see more and see better you can do more and do better (22). Given that the majority of patients have stage I or II disease, we can conclude that the robot has no added value for the treatment of early stage endometriosis. Its value lies in the management of severe cases of endometriosis and converting laparotomies to laparoscopies for more advanced cases. Robotic surgery for endometriosis was successful for stage IV endometriosis without conversion to laparotomy. Other investigators have reported conversion to laparotomy to be around 10% (23). Perhaps the use of computer-enhanced technology should be reserved as an enabling device for more severe cases, such as segmental bladder, bowel and ureteral resection, for the treatment of endometriosis (3).

One of the major benefits of RAL is its 3D technology. In comparison with the traditional two-dimensional flat view of the surgical field, it eliminates sensory loss and improves depth perception. In addition, RAL allows for improved dexterity and filtration of the surgeon's tremor and also improved intuitive movements (11, 15). In practice, the 7 degrees of freedom and 3D visual image permit easier handling of the tissue and would allow the less skilled laparoscopic surgeon to perform suturing in a shorter period of time when compared with standard laparoscopy (24). Although our RAL procedures were significantly longer than the SL procedures, robot assisted surgery provides the ergonomic advantage of sitting comfortably at a console, allowing the surgeon to perform

TABLE 1

Demographics.

	RAL (n = 40)	SL (n = 38)	*P* value
Age (y), mean (range)	35 (22–49)	33 (18–46)	.205
BMI mean (range)	24 (19–37)	23 (18–31)	.283
Patients with previous pelvic surgery, %	45% (18)	40% (15)	.481

Note: RAL = robot assisted laparoscopy; SL = standard laparoscopy; BMI = body mass index.

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TABLE 2

Distribution of stage of endometriosis.

Stage of endometriosis	I	II	III	IV
Robotic	14	17	7	2
Non- Robotic	14	16	5	3

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TABLE 3

Operative outcomes.

	RAL (n = 40)	SL (n = 38)	*P* value
Mean operative, (min) (range)	191 (135–295)	159 (85–320)	.045
Mean blood loss, ml (range)	60 (0–350)	65 (0–500)	.823
Intraoperative and postoperative complications	0	0	n/a

Note: RAL = robot assisted laparoscopy; SL = standard laparoscopy; n/a = not available.

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for a longer period of time and with less fatigue. Disadvantages include the cost of implementation and maintenance, lack of tactile feedback to the surgeon, the presence of bulky robotic arms, long and thick cords, and the inability to move the surgical table once robot arms are attached and operate in different quadrants at same time.

Current robotic technology is far from universal. Two of the largest hindrances to the global implementation of this procedure are cost and education. Smaller, cheaper, and easier to use robots are going to make this alternative form of surgery faster and more cost-effective. It is also suitable for telesurgery and more advanced precise surgical procedures. As it has been previously stated, robotic surgery is a form of endoscopic surgery and it would be more appropriate for future studies to compare robotic surgery with laparotomy rather than laparoscopy. We believe that comparing it with laparotomy, robotic surgery will prove to have all the benefits of minimally invasive surgery. As such, there is exciting potential for future applications of this technology in treating different pathologies, telemedicine, and telesurgery. The main limiting factors for performing standard laparoscopy are the surgeons' skills, experience, and the availability of proper instrumentation. Robotic assistance may enable more surgeons to do laparoscopic surgery and convert their open procedures to endoscopy.

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