Robot-assisted Laparoscopic Staging Surgery for Endometrial Cancer—A Preliminary Report

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SUMMARY

Objective: The robotic surgical system is reported to overcome some technical difficulties in traditional laparoscopic hysterectomy. This study aimed to evaluate the feasibility and surgical outcomes of a robotic surgery program for endometrial cancer.

Materials and Methods: Patients with endometrial cancer with the intention to receive treatment using robot-assisted laparoscopic staging surgery were recruited in a university hospital from July 2007 to August 2008. All of these surgeries were performed with the da Vinci system.

Results: Six patients (mean age, 47.5 ± 1.4 years; mean body mass index, 26.2 ± 3.5 kg/m^2) were enrolled and completed robot-assisted laparoscopic staging surgery. The robot docking time was 45.0 ± 13.6 minutes and the robot-assisted operation time was 200.3 ± 30.0 minutes. The mean estimated blood loss was 180.0 ± 147.6 mL. The mean number of lymph nodes retrieved was 23.2 ± 7.4. No laparoconversion and no intraoperative or post-operative complications occurred. All patients were alive and free of disease up to the date of this report, at a median follow-up of 6.5 months (range, 5–17 months).

Conclusion: Robot-assisted laparoscopic staging surgery is a feasible treatment and helps overcome the technical limitations in conventional laparoscopy for endometrial cancer. [*Taiwan J Obstet Gynecol* 2010;49(4):401–406]

Key Words: endometrial cancer, laparoscopic staging surgery, robotic surgery, surgical outcomes

Introduction

Endometrial cancer is one of the most common gynecologic malignancies. In the United States, it is estimated that there are 42,100 annual new cases and 7,400 deaths resulting from this disease [1]. In Taiwan, the incidence of endometrial cancer has increased rapidly; it affected approximately 250 women in 1995, 418 women in 2000, and approximately 1,100 in 2007, according to the Taiwan Society of Cancer Registry.

The trend has shown an increasing application of minimally invasive techniques in the surgery of gynecologic cancer to minimize morbidity and recovery time. Since the early 1990s when Childers et al demonstrated the feasibility of laparoscopic-assisted surgical staging of endometrial cancer [2–4], this approach has been increasingly utilized by gynecologic oncologists [3]. However, laparoscopic cancer surgery was still limited by technique barriers of a high learning curve, long operation time, and limitations in performing complex surgical procedures [5].

The da Vinci Surgical System (Intuitive Surgical, Inc., Sunnyvale, CA, USA) has been reported to overcome some technical difficulties in traditional laparoscopic hysterectomy; however, its application for staging

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surgery of endometrial cancer is still relatively new [6–8]. Currently, we are the first institute to establish a program of robot-assisted laparoscopic staging surgery for endometrial cancer in Taiwan. The present study aims to evaluate the outcomes of the surgical procedures and the feasibility of this robotic surgery program.

Materials and Methods

A retrospective chart review was carried out for patients of endometrial cancer with the intention to treat the disease with robot-assisted laparoscopic staging surgery procedures at the Chang Gung Memorial Hospital between July 2007 and August 2008. All patients gave their written informed consent, and all procedures were performed by the senior author (Dr C.L. Lee).

Operation procedure

After general anesthesia, the patient was placed in the low lithotomy position with arms padded and tucked in. Once pneumoperitoneum was achieved, the patient was placed in a steep Trendelenburg position, and all ports were placed (to be described). The patient-side cart (of the da Vinci Surgical System) was then driven between the patient's legs, and each responsible port was docked onto the assigned robotic arms, except for the ones operated by the assistant surgeon standing at the left side of the patient.

Trocar placement

Four or five ports were used as shown in the Figure. A primary puncture of a 12-mm port for the laparoscope was placed at the Lee-Huang point [9], which was placed 3–5 cm above the umbilicus. Two 8-mm ports were placed at the level of the umbilicus and 10–12 cm laterally on either side and docked onto the robotic arms. A fourth puncture, which was a 12-mm port placed between the laparoscope and the left robotic port, was for the assistant surgeon who was in charge of suction, irrigation, exposing the field, introducing sutures, and removing specimens. For complex cases, a fifth 10-mm port was placed between the primary and the right robotic port for handling of powerful vasculature sealing instruments, such as the 10-mm Ligasure Atlas (Valleylab, Covidien) or EndoGIA (Auto Suture, Covidien).

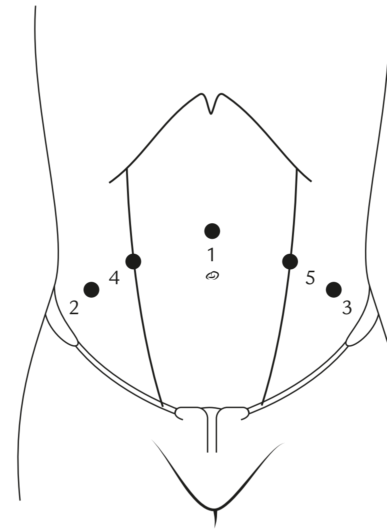

Figure. Sketch demonstrating the location of trocar placement. Four or five trocars were inserted as follows: (1) the primary trocar was at the Lee-Huang point (3–5 cm above the umbilicus) and was for laparoscopic camera insertion; (2) & (3) two 8-mm ports 10–12 cm lateral to the umbilicus on either side were for the robotic arms and instruments; (4) an accessory port was for the assistant surgeon standing at the left side of the patient; and (5) in complex cases, an additional port was established.

Instrumentation

A zero-degree endoscope was used for the entire procedure. We used an EndoWrist plasma-kinetic bipolar grasper in the left robotic hand and EndoWrist monopolar curved scissors in the right hand (Intuitive Surgical Inc., Sunnyvale, CA, USA). A Koh colpotomizer and RUMI uterine manipulator (Cooper Surgical, Pleasanton, CA, USA) were used to identify the vaginal fornices during hysterectomy. The uterine balloon was filled with 5 mL sterile saline, and a vaginal colpo-pneumo occluder balloon was filled with 60–100 mL of air.

Lymphadenectomy

Once the whole abdominal cavity was surveyed and washing cytology obtained, the retroperitoneal space was explored by incising the peritoneum overlying the psoas muscle from the pelvic brim to the round ligament, in a direction lateral and parallel to the infundibulopelvic ligament using sharp dissection via bilateral robotic hands. After identification of the pelvic vessels and ureters, dissection of lymph nodes began from the bifurcation of the common iliac vessels to the crossover of the deep circumflex iliac vein over the external iliac artery. The obturator space was exposed by lateral retraction of the external iliac vein, and lymphatic tissues were dissected from posterior attachment to the external iliac vein and lateral attachment to the pelvic sidewall to the obturator nerve. Para-aortic lymphadenectomy began by incising the peritoneum from the bifurcation of the aorta to the level of the inferior mesenteric artery, and the lymphatic tissue overlying the aorta and vena cava was removed. All nodal tissue was retrieved in an endobag to avoid contact with the abdominal wall.

It was not necessary to change to different EndoWrist instruments during the lymphadenectomy.

Hysterectomy
All robot-assisted laparoscopic hysterectomy performed in this series was type IVE according to the American Association of Gynecologic Laparoscopists classification system, which meant that there was total laparoscopic removal of the uterus and cervix including vaginal cuff closure [10]. Vascular pedicles were taken with a plasma-kinetic bipolar cautery and transected with a monopolar cautery. A circumferential colpotomy was performed with monopolar scissors on the superior margin of the Koh ring, and vaginal closure was performed using 0 Vicryl sutures on CT-1 needles with a continuous non-running lock technique using the needle driver on the right arm and plasma-kinetic bipolar grasper remaining on the left arm.

Data analysis
Patient demographics, intraoperative findings, postoperative outcomes, and pathologic reports were all prospectively recorded as patients enrolled in the study. Feasibility of the program was evaluated with parameters of surgical procedures and outcomes, including docking time, operation time, estimated blood loss, length of hospital stay, intraoperative and postoperative complications, and number of lymph nodes retrieved. Robot docking-time was defined as the time from the robot advancing to the patient to the time that all ports were connected to robotic arms. Operation time was counted from the complete docking of the robot to skin closure at the end of surgery. Age and body mass index were considered as continuous variables, while parity and the number of lymph nodes retrieved were considered as discrete variables. Normality testing of data distribution was performed with the Kolmogorov-Smirnov test in which data with normal distributions are presented as mean ± standard deviation, while data without normal distributions are presented as median value and range. Incidence is presented as a percentage.

Results

From July 2007 to August 2008, six patients with endometrial cancer, with a mean age of 47.5 ± 1.4 years and mean body mass index of 26.2 ± 3.5 kg/m^2, were recruited and underwent robot-assisted procedures completely without conversion to traditional laparoscopy or laparotomy. The demographic background of the patients is listed in Table 1.

All the robot-assisted surgeries completed the staging surgery procedures, including collecting washing cytology, total laparoscopic hysterectomy, bilateral salpingo-oophorectomy, and bilateral pelvic/para-aortic lymphadenectomy. For preparation of the robot, the mean docking time was 45.0 ± 13.6 minutes and the robot-assisted operation time was 200.3 ± 30.0 minutes. The mean estimated blood loss was 180.0 ± 147.6 mL throughout the procedure. No blood transfusions were administered in the present series. All patients were discharged on the third day after the operation (Table 2).

The results of the pathologic examination are listed in Table 3 and the staging was based on the International Federation of Gynecology and Obstetrics (FIGO) system. The final pathology revealed three patients with

Table 1. Patient demographics

Case	Age (yr)	Weight (g)	Height (cm)	BMI (kg/m^2)
1	50	59.6	158.0	24
2	46	60.0	149.5	27
3	47	56.8	157.0	23
4	47	58.6	158.0	23
5	48	63.0	150.0	28
6	47	86.4	165.0	32

BMI = body mass index.

Table 2. Intraoperative data

Case	Robotic procedure	Docking time (min)	Op. time (min)	EBL (mL)	Complication
1	Washing cytology + BPLD/PALD + BSO + TLH	67	242	100	Neg
2	Washing cytology + BPLD/PALD + BSO + TLH	52	220	300	Neg
3	Washing cytology + BPLD/PALD + BSO + TLH	48	213	30	Neg
4	Washing cytology + BPLD/PALD + BSO + TLH	37	180	50	Neg
5	Washing cytology + BPLD/PALD + BSO + TLH	29	160	200	Neg
6	Washing cytology + BPLD/PALD + BSO + TLH	37	187	400	Neg

BPLD = bilateral pelvic lymph node dissection; PALD = para-aortic lymph node dissection; BSO = bilateral salpingo-oophorectomy; TLH = total laparoscopic hysterectomy American Association of Gynecologic Laparoscopists Class IV-E; Op. time = operation time; EBL = estimated blood loss; Neg = negative.

Table 3. Pathologic examination and postoperative course

Case	Pathology	Grade	Cytology	Node yield	FIGO stage	Adjuvant theraphy	Disease status	Follow up (mo)
1	Atypical complex hyperplasia with focal endometrioid adenocarcinoma	1	Neg	9	Ia	Megace (40) 1# qd for 1 yr	NED	17
2	Atypical complex hyperplasia with focal endometrioid adenocarcinoma	1	Neg	25	Ia	None	NED	16
3	Well-differentiated endometrioid adenocarcinoma	1	Neg	27	Ia	None	NED	7
4	Well-differentiated endometrioid adenocarcinoma	1	Neg	30	Ia	Megace (40) 1# qd	NED	6
5	Moderately differentiated endometrioid adenocarcinoma and stromal invasion with left ovarian microscopic metastasis	2	Neg	22	IIIa	Radiotherapy: true pelvis 5,040 cGy, Vagina: 200 cGy	NED	5
6	Atypical complex hyperplasia with focal endometrioid adenocarcinoma	1	Neg	26	Ia	Megace (40) 1# qd	NED	5

FIGO = International Federation of Gynecology and Obstetrics; NED = no evidence of disease; Neg = negative.

atypical complex hyperplasia with focal endometrioid adenocarcinoma, two patients with well-differentiated endometrioid adenocarcinoma, and one patient with moderately differentiated endometrioid carcinoma with stromal invasion and with ovarian microscopic metastasis (FIGO stage IIIa), who subsequently underwent radiotherapy after the operation. The mean number of lymph nodes retrieved was 23.2 ± 7.4. All patients were alive and disease free up to the date of this report, with a median follow-up of 6.5 months (range, 5–17 months). No complications, port-site metastases, or recurrences occurred in the present series.

Discussion

Because of the avoidance of a long abdominal incision, laparoscopic surgery offers advantages of reduced postoperative morbidity, shorter hospital stay, and rapid recovery. Many investigators have advocated endoscopic approaches in cancer surgery [11–13]. In a prospective randomized trial of laparoscopy versus laparotomy for the comprehensive surgical staging surgery of endometrial cancer, which enrolled 2,616 women, laparoscopic surgical staging surgery was feasible for most women with clinical stage I-IIA uterine cancer (Gynecologic Oncology Group-LAP2) [14]. However, a review of endometrial cancer treated in California from 1997 to 2001 revealed that only 8% of patients underwent this minimally-invasive surgical approach [15]. Reasons for this lack of application include difficulties in training and mastery of the surgical procedures, a prolonged operation time, physical demands of non-ergonomic surgery, and concerns of individual surgeons about the efficacy and safety of laparoscopic lymphadenectomy.

Although the advantages have not yet been established, robot-assisted laparoscopic surgery using the da Vinci surgical system overcomes many difficulties in standard laparoscopic procedures because of improvements in optics, ergonomics, and wristed-motion instrumentation that enables the improvement of precision and control [16]. The first total robotic hysterectomy was reported by Diaz-Arrastia et al in 2002 [17]. They reported 41 patients who underwent robot-assisted laparoscopic surgeries with 20 patients who had endometrial, ovarian, or cervical cancer. The overall data showed little estimated blood loss (253 mL), short hospital stay (average, 2.5 days), a low overall complication rate of 7.3%, and no laparoconversion [18].

There are few reports of robot-assisted surgeries for endometrial cancer. Table 4 lists the comparisons of our preliminary results with the published data [19–24]. The average body mass indices range from 26.1 to 35.3, and the mean operation times range from 3 hours to 4 hours. The estimated blood loss ranges from 63 mL to 180 mL. The mean lymph nodes retrieved varies in a wide range from 10.4 to 29.8. Some studies reported a range of complication rates from 3.6% to 7.5%; however, there were no complications in our series.

There was an unavoidable learning curve. In the present series, the robot-assisted operation times were longer than those in earlier cases but this later decreased, although statistical significance was not seen. A similar trend was found in the number of lymph nodes retrieved, which was the most important parameter for the completeness of lymphadenectomy. Except for the first case, the yields of lymph-node number were more than 22 in the last five cases, which showed that this was adequate for lymphadenectomy in robotic surgery. One of the reasons for these findings could be because all the procedures were performed by the same senior endoscopist serving as a console surgeon and the same junior endoscopic surgeon served as an assistant. This could have allowed a rapid accumulation of experience throughout the preparation and handling of the procedures, to facilitate a rapid familiarity and competence of the surgical technique. Our docking time also decreased after establishment of the paramedical "robotic surgery team", which was composed of senior circulating and scrub nurses. The team's ability to calibrate, apply sterile draping, and facilitate docking of the robot was greatly improved after gaining experience.

There are several obvious disadvantages in robot-assisted laparoscopy compared with traditional laparoscopy and laparotomy. It took much longer to prepare for the surgical procedure, especially for the set up and docking of the robotic system. Even after improvement of preparation and docking procedures, it still took more than 30 minutes. The cost is also much more expensive than that of laparoscopy and laparotomy. To reduce the cost, we only used three types of EndoWrist instruments (monopolar curved scissors, a plasmakinetic bipolar grasper, and needle driver) during the whole procedure.

In conclusion, for patients with endometrial cancer, robot-assisted laparoscopic staging surgery appears to be a safe and effective surgical treatment, which allows an easier and more comprehensive lymphadenectomy, overcoming the technical limitations found in conventional laparoscopy, and improving the staging surgery process for endometrial cancer. These advantages contributed to the minimal invasiveness in surgical treatment for uterine cancer. However, the high cost of robotic surgery is a concern for increasing medical expenses. Larger multi-institutional studies with long-term follow-up are needed to confirm our preliminary findings.

Table 4. Comparison of the current results with the recent studies on robot-assisted laparoscopic staging surgery for endometrial cancer*

Author	Patients (*n*)	Age (yr)	BMI (kg/m^2)	Op. time (min)	EBL (mL)	LOS (d)	Lymph nodes	Complication rate (%)	Laparo-conversion (%)
Lowe et al [19]	405	62.2	32.4	170.5±68.9	87.5±97.4	1.8±2.8	15.5±9.6	18.1	6.7
Seamon et al [20]	105	59 (34–82)	34 (19–58)	242±50	99±83	1 (1–46)	29 (9–56)	–	12.4
Boggess et al [21]	103	61.9±10.6	32.9±7.6	191.2±36.0	74.5±101.2	1±0.2	32.9±26.2	5.8	2.9
Bell et al [22]	40	63.0±10.1	33.0±8.5	184.0±41.3	166.0±225.9	2.3±1.3	17.0±7.8	7.5	–
DeNardis et al [23]	56	58.9±10.3	28.5±6.4	177±55	105±77	1.0±0.5	18.6±12.4	19.7	5.4
Peiretti et al [24]	80	58.3±11.5	25.2±6.1	181.1±63.1	43.6±26.5	2.5±1.1	17±8.5	23.7	3.7
Present study	6	47.5±1.4	26.1±3.5	200±30	180±147	3	23.1±7.4	0	0

Data are presented as mean ± standard deviation or median (range). BMI = body mass index; Op. time = operation time; EBL = estimated blood loss; LOS = length of stay.

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