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Laparoscopic Versus Robotic Hysterectomy in Obese Patients With Early-stage Endometrial Cancer: A Single-centre Analysis

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Abstract. *Background/Aim: To compare the surgical outcomes of robotic and laparoscopic hysterectomy with or without pelvic lymphadenectomy among obese patients [body mass index (BMI) >30 kg/m^2] with early-stage endometrial cancer. Patients and Methods: We examined 42 obese patients with early-stage endometrial cancer who underwent laparoscopic (LH) or robotic hysterectomy (RH) between April 2014 and April 2020 in our institution. We analysed intraoperative and postoperative data for both procedures. Results: Of the 42 women, 22 and 20 patients underwent RH and LH, respectively, with or without pelvic lymphadenectomy. The operation times, harvested lymph nodes, and BMI did not differ between the groups. In the subset of patients who underwent pelvic lymphadenectomy, those in the RH group had shorter hospital stays (p=0.001) and less intraoperative bleeding (p=0.006). Conclusion: Obese patients with endometrial cancer who underwent robotic surgery had less blood loss and shorter hospital stays than those who underwent laparoscopic surgery.*

Endometrial cancer-related morbidity and mortality are increasing worldwide. In Japan, endometrial cancer is the fifth most common cancer, with an estimated incidence of 16,724 cases in 2017. Obesity is a risk factor for endometrial cancer and also increases the cancer-related and all-cause mortality (1-3). Japan has noted a recent increase in obesity and a proportional increase in the incidence of endometrial cancer among obese women.

Laparoscopic surgery reduces the perioperative risks associated with performing procedures in obese patients and also requires shorter hospital stays and carries a lower risk for wound infections and postoperative fever than laparotomy (4-6). A minimally invasive approach should be considered in all obese patients with gynaecologic malignancies. However, conventional laparoscopic surgery becomes technically more difficult as a patient's body mass index (BMI) increases because subcutaneous and visceral fat limit the entry, visualisation, and manipulation during surgery. These result in prolonged operative times and surgeon fatigue (7). Compared to laparoscopic surgery, robotic surgical systems improve visibility and instrumentation and facilitate surgery in obese patients.

Our retrospective study compared the surgical outcomes of robotic and laparoscopic hysterectomy (RH and LH, respectively) with or without pelvic lymphadenectomy among obese patients (BMI >30 kg/m^2) with early-stage endometrial cancer.

Patients and Methods

This retrospective cohort study was approved by the institutional review board of Mie University Hospital. We analysed 42 obese women diagnosed with stage IA endometrial cancer using magnetic resonance imaging (MRI) and who underwent LH or RH with or without pelvic lymphadenectomy. LH was performed between April 2014 and April 2020, whereas RH using the Da Vinci Si or Xi systems (Intuitive Surgical Inc®, Sunnyvale, CA, USA) was performed beginning October 2017. All patients underwent preoperative evaluation, and any comorbidities were medically cleared prior to the operation. Patients were selected for robotic surgery if they did not have comorbidities, glaucoma, or cerebrovascular disorders.

Until 2014, our surgical technique for endometrial cancer consisted of a total hysterectomy with bilateral salpingo-oophorectomy and pelvic and paraaortic lymphadenectomy via open laparotomy, regardless of the histology and presumed clinical stage. However, we modified our approach after the introduction of laparoscopic surgery. We omitted lymphadenectomy in patients with grade 1 or 2 endometrial cancer without signs of myometrial invasion on MRI but performed pelvic lymph node dissection in patients with <50% myometrial invasion on MRI. We conventionally performed pelvic and paraaortic lymph node dissection in patients with ≥50% myometrial invasion on MRI or grade 3 endometrial carcinoma, clear cell carcinoma and serous carcinoma, but we excluded these patients from our study because the Japanese health insurance does not cover paraaortic lymph node dissection using minimally invasive surgery.

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Key Words: Endometrial cancer, robot surgery, laparoscopic surgery, obesity.

The data collected included patient age, BMI, comorbid conditions, previous abdominal surgeries, procedure performed, histology, operative time, practical operative time, estimated blood loss (EBL), conversion rate, number of harvested pelvic lymph nodes, perioperative complications, transfusion, length of hospital stay, and postoperative complications. Operative time was defined as the time from incision to wound closure, whereas practical operative time was defined as the console and procedure times in RH and LH, respectively. Intraoperative complications included major bowel, bladder, ureteral, vessel, and nerve injuries. Postoperative complications (hematoma, wound infection or separation, and venous thromboembolic events) within 30 days of surgery were recorded.

Statistical analysis was performed using SPSS version 27.0 (SPSS Inc., Chicago, IL, USA). Continuous and categorical variables are presented as medians and percentages, respectively. Continuous variables were analysed using the Kruskal-Wallis test or Mann-Whitney *U*-test, whereas categorical variables were analysed using the χ^2-test or Fisher's exact test, as appropriate. A $p<0.05$ was considered statistically significant.

Results

Patient characteristics. We investigated 42 women with BMI >30 kg/m^2 and endometrial cancer. Of the 42 patients, 20 underwent LH and 22 underwent RH, with or without pelvic lymphadenectomy. The LH and RH groups showed no significant differences in terms of age ($p=0.480$), BMI ($p=0.900$), comorbid conditions ($p=0.181$), previous abdominal surgery ($p=0.303$), histology, grading, and number of harvested lymph nodes (Table I).

Intraoperative outcomes. Intraoperative outcomes are summarised in Table II. The median total operative time was 249 min (range=206-393 min) and 230 min (range=154-580 min) in the RH and LH groups, respectively. There was no significant difference between the groups ($p=0.151$). The median practical operative time was 175 min (range=110-308 min) and 207 min (range=135-445 min) in the RH and LH groups, respectively. There was no significant difference between the groups ($p=0.321$). The median EBL was 3 ml (range=3-500 ml) and 54 ml (range=3-1,454 ml) in the RH and LH groups, respectively. There was no significant difference between the groups ($p=0.121$).

Pelvic lymphadenectomy was performed in 41% (9/22) and 55% (11/20) of the patients who underwent RH and LH, respectively. The median number of pelvic lymph nodes was 28 (range=21-39) and 26 (range=7-47) in the RH and LH groups, respectively. No significant difference was noted between the groups ($p=0.71$). However, among patients who underwent lymphadenectomy, there was a significant difference in the EBL between both groups [RH: 3 ml (range=3-100) *vs*. LH: 150 ml (3-730 ml), $p=0.006$].

No intraoperative complications were noted in any of the patients. None of the cases were converted to laparotomy or required intraoperative blood transfusion (Table II).

Postoperative outcomes. The median length of hospital stay was shorter in the RH group [RH: 7 days (range=6-9) *vs*. LH: 8 days (range=6-17), $p=0.001$]. None of the patients in either group developed postoperative intestinal trauma, intestinal obstruction, symptomatic lymphatic cyst, or lymphoedema. Two patients in the LH group required re-operations for compartment syndrome and vaginal discharge, whereas no re-operation was needed in the RH group. Two patients from each group developed non-reducible port-site incisional hernias. The median follow-up time was 18 months (range=9-34 months) and 47 months (range=1-66 months) for the RH and LH groups, respectively. No signs of recurrence of endometrial cancer were observed in either group.

Discussion

This is the first report that compared the results of laparoscopic and robotic surgery among obese patients with endometrial cancer in Japan. Our study demonstrated that RH was associated with significantly shorter hospital stays ($p=0.001$). Among patients who underwent lymphadenectomy, RH also resulted in significantly lesser blood loss than LH ($p=0.006$).

Surgery has traditionally been delayed or avoided in morbidly obese patients because of the challenges associated with their comorbidities or in accessing the pelvic organs (8). However, recent reports have demonstrated that robotic surgery is safe and feasible, particularly for obese patients with endometrial cancer (9, 10). Robotic surgery is superior to laparoscopy because it provides better access to the abdominal cavity, surgical instrument mobility, and visualisation owing to its three-dimensional view (11). Several previous studies have compared RH with LH (Table III). Rut *et al*. (12) and Garcia *et al*. (13) demonstrated that EBL is lower following RH in obese patients with endometrial cancer. However, a systematic review (14) reported that RH and LH have similar incidences of perioperative complications, such as blood transfusion, bowel, bladder, and vessel injury, and venous thromboembolism. In one of the largest studies to date (RH: n=249 *vs*. LH: n=406), Corrado *et al*. (15) reported no significant difference in the blood loss between LH and RH.

In the present study, blood loss was significantly lower during RH with lymphadenectomy than during LH with lymphadenectomy ($p=0.006$). During pelvic lymphadenectomy, the area around the internal iliac vein is difficult to dissect and most prone to bleeding; Freytag *et al*. highlighted that this area is prone to complications because of its topographical complexity (16). The common iliac artery arises from the aorta anteriorly over the left side of the fourth lumbar vertebra. The common iliac artery then divides into the internal and external iliac arteries, and the common, internal, and external veins are located medial or dorsomedial to their arterial equivalents. The left ureter crosses under the sigmoid mesocolon and overlies the common iliac artery; this area is a particularly difficult area to

Table I. *Patient demographics and pathology results*[a].

	Laparoscopy (n=20)	Robot surgery (n=22)	*p*-Value
Age (years)	49 (33-59)	50 (30-66)	0.48
BMI (kg/m^2)	35.7 (30.8-57.0)	36.2 (30.5-48.0)	0.9
Comorbidity[b]	17 (85%)	15 (68.2%)	0.181
Previous abdominal surgery	6 (30%)	10 (45.6%)	0.303
Histological subtype			
Endometrioid	20 (100%)	22 (100%)	
Histological grade			0.072
Grade 1	15	21	
Grade 2	5	1	
Grade 3	0	0	
Lymph node dissection	11 (55%)	9 (41%)	0.361
Myometrial invasion (%)			0.267
<50%	17	21	
>50%	3	1	

[a]Values are reported as number (percentage) or median (range); [b]Includes hypertension, diabetes, and heart disease.

Table II. *Perioperative outcomes*.

	Laparoscopy (n=20)	Robot surgery (n=22)	*p*-Value
Hospital stay (days)	8 (6-17)	7 (6-9)	0.001
Total operative time (min)	230 (154-580)	249 (206-393)	0.151
Practical operative time (min)	207 (135-445)	175 (110-308)	0.321
Blood loss (ml)	54 (3-1,454)	3 (3-500)	0.121
Blood loss (ml) with lymphadenectomy	150 (3-730), (n=11)	3 (3-100), (n=9)	0.006
Pelvic nodes (n)	26 (7-47)	28 (21-39)	0.710
Conversion to laparotomy	0	0	N/A
Transfusion	0	0	N/A
Complications			0.313
Port-site hernia	2	2	
Compartment syndrome	1	0	
Vaginal discharge	1	0	
Cancer recurrence	0	0	
Follow-up time (months)	47 (5-66)	18 (9-34)	

N/A: Not available.

visualise during minimally invasive surgery. Figure 1 compares the view of the abovementioned area during robotic and laparoscopic surgery. Robotic surgery provides a three-dimensional image, which allows the surgeon to extend instruments closer to the involved structures. Moreover, the robotic trocars themselves lift the abdominal wall, which provides a wider operating field for the surgeon and reduces intrathoracic pressure for the anaesthesiologist (17). While our operative times were long, we had less of the anaesthesia-related complications expected in obese patients and overall lower amounts of blood loss, particularly among patients who underwent RH with lymphadenectomy. Reducing blood loss in obese patients is important because it provides better perioperative outcomes, particularly in patients with cardiovascular comorbidities.

The Gynecologic Oncology Group's LAP2 trial compared laparoscopic surgery and laparotomy for endometrial cancer and demonstrated a 25% conversion rate among patients with a median BMI of 28 kg/m^2 (7). Cusimano *et al*. showed that 5.5% of RH and 6.5% of LH performed in patients with BMI >30 kg/m^2 were converted to laparotomy. In patients with BMI >40 kg/m^2, 7% and 3.8% of RH and LH, respectively, were converted to laparotomy. More than 30% of the LH conversions were due to obesity-related anaesthetic complications, whereas only 6% of the RH conversions were made for the same reason (14). None of the patients in our study required conversion. Compared to other reports, our technique resulted in less blood loss and more harvested lymph nodes but also longer operative times.

Table III. *Review of the studies comparing robotic surgery and laparoscopy in obese patients with endometrial cancer.*

Author (year)	No patients		Median BMI (kg/m^2)		Median OT (min)		Median EBL (ml)		Lymph node dissection (%)		Median No. of lymph node		Conversion rate (%)		Transfusion rate (%)	
	LH	RH	LH	RH	LH	RH	LH	RH	LH	RH	LH	RH	LH	RH	LH	RH
Present study (2021)	20	22	35.7	36.2	230	249	54	3	55.0	41.0	26	28	0	0	0	0
Garcia *et al.* (2020) (13)	22	59	33.3	33.5	180	150	180	87.5	41	39	16	16	27.3	3.4	4.5	5.1
Rut *et al.* (2019) (12)	18	26	37	36	195	150	200	125	83	17	8.5	17[#]	NR	NR	NR	NR
Corrado *et al.* (2018) (15)	406	249	33.7	34.2	120	170	50	50	19.7	40.3	12	15	3.7	3.2	0.5	1.6

No.: Number; LH: laparoscopic hysterectomy; RH: robotic hysterectomy; BMI: body mass index; OT: operation time; EBL: estimated blood loss; NR: not reported. [#]includes pelvic and para-aortic lymphadenectomy cases.

During the study period, our centre performed 128 laparoscopic and 102 robotic surgeries for uterine cancer. Our study demonstrated that robotic surgery is superior to laparoscopic surgery, especially in obese patients, but the learning curve may be a significant factor. In the RH group, the median total operative time and median practical operative time were 249 min and 175 min, respectively. The total operative time was longer because performing minimally invasive procedures in obese patients is difficult; long operative times are also associated with higher costs. In contrast, the practical operative time was shorter, which indicated that overall surgical times for RH may be shortened further with more experience.

This study compared the surgical outcomes between robotic and laparoscopic surgery performed in obese patients with early-stage endometrial cancer. In the subset of patients who underwent RH with lymphadenectomy, there were significant differences in the duration of hospital stay and EBL. Despite long operating times, none of our patients required blood transfusion or conversion to open surgery. However, a major limitation of this study was its short follow-up period; an adequate follow-up period is important, particularly because we assessed the success of treatment options for gynaecologic malignancies. In most patients without residual tumours, endometrial cancer recurred within 2 years, irrespective of the clinical stage or type (18). The present study showed no significant difference in the prognosis for early-stage endometrial cancer between the groups. Our data demonstrated that robotic surgery has acceptable oncologic outcomes for these patients. Other limitations of this study were its small sample size and retrospective design.

In conclusion, our study demonstrated that robotic surgery is feasible and safe for obese patients with early-stage endometrial cancer. RH provides the surgeon with better intraoperative anatomical orientation and less blood loss than LH. Future research should examine a larger sample of patients and longer follow-up data, as well as to accumulate data that can be obtained only with robotic surgery.

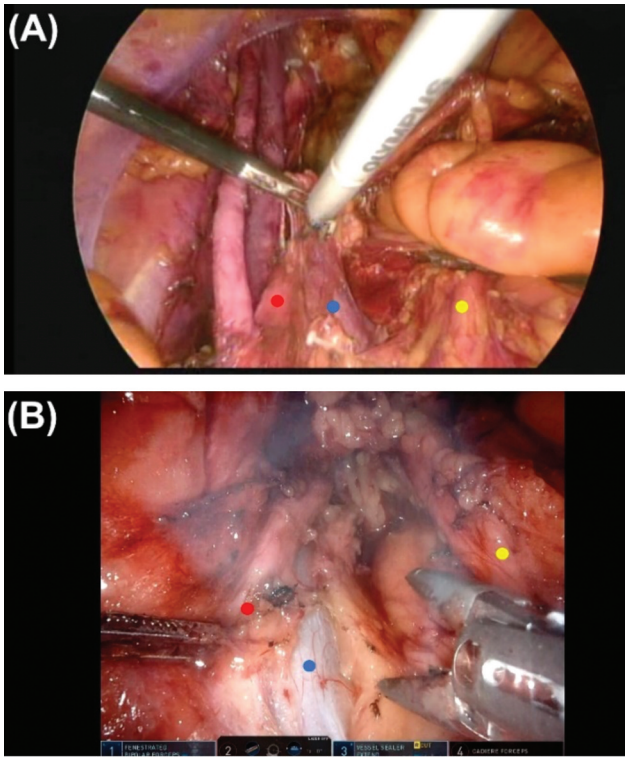

Figure 1. *Intraoperative image of hysterectomy with pelvic lymphadenectomy. The pelvic lymph nodes near the bifurcation of the external and internal iliac arteries are clearly visualized. Robotic surgery (B) does not interfere with the instruments and camera, so that the nodes can be viewed more closely than in laparoscopic surgery (A). Left internal artery (red circle); left internal vein (blue circle); left ureter (yellow circle).*

Conflicts of Interest

The Authors have no conflicts of interest regarding this study.

Authors' Contributions

Conception and design: Kenta Yoshida, Eiji Kondo; Acquisition of data: Kenta Yoshida, Ryo Nimura, Shintaro Maki; Analysis and interpretation of data: Kenta Yoshida, Michiko Kaneda; Drafting of the manuscript: Kenta Yoshida, Eiji Kondo; Critical revision of the manuscript for important intellectual content: Michiko Kaneda, Masafumi Nii; Final approval of the article: Tomoaki Ikeda.

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