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ORIGINAL RESEARCH

Robot-assisted surgery for early uterine corpus cancer: assessing the learning curve

Masakazu Nishida[1,*], Kaei Nasu[1], Kentaro Kai[1], Mitsutake Yano[1], Yasushi Kawano[1]

[1]Department of Obstetrics and Gynecology, Faculty of Medicine, Oita University, 879-5593 Oita, Japan

***Correspondence**
nishida@oita-u.ac.jp
(Masakazu Nishida)

Abstract

Minimally invasive surgery (MIS) is performed for various human cancers, among which robot-assisted surgery is widely used in the United States, Europe, and other countries. Presently, the total number of robot-assisted surgeries in gynecology exceeds that in urology and any other clinical department. Our group began using robot-assisted surgery for early-stage uterine corpus cancer as from November 2017 and has already performed 40 robot-assisted operations. For this study, we examined the cases of 35 patients, excluding 3 in whom lymphadenectomy was not performed and 2 who underwent additional vaginal wall plasty. Compared with the first 20 cases, the latter 15 had reduced bleeding and shorter operation times. No serious complications were observed in the whole cohort, but infections, including urinary tract infections and peritonitis, were common among the first 20 patients. Although robot-assisted surgery is considered more advantageous for obese patients than laparoscopic and open surgery, we found no significant differences in bleeding, surgical time, or the number of resected lymph nodes between obese patients (Body Mass Index (BMI) $\geq$30) and other patients in this present study. Robot-assisted surgery is expected to be more widely used, and further technical improvements are needed.

Keywords

Robot-assisted surgery; Uterine corpus cancer; Laparoscopic surgery; Learning curve

1. Introduction

The use of minimally invasive surgery (MIS) in obstetrics and gynecology began with surgery for benign ovarian and uterine tumors and is now being used for early-stage uterine cervical or uterine corpus cancers and pelvic uterine prolapse. The results of the GOG-LAP2 (Laparoscopy Compared with Laparotomy for Comprehensive Surgical Staging of Uterine Cancer: Gynecologic Oncology Group Study LAP2) study (NCT00002760) in 2009 [1] indicated no difference in prognosis between laparotomy and laparoscopy in early-stage uterine corpus cancers and improved surgical outcomes, such as shorter hospital stays and fewer complications, for patients who underwent laparoscopy compared with laparotomy [2, 3]. Laparoscopic surgery for early-stage uterine corpus cancer and cervical cancers started to be covered by public insurance in 2014 and 2019, and is being widely performed in Japan. Robot-assisted surgery began to be used for prostate cancers due to its initial benefit of an enlarged view of the urological field. It is now indicated for colorectal, stomach, lung, bladder and uterine corpus cancers. Robot-assisted gynecologic surgery is indicated for uterine myoma, a benign disease, and the number of cases of robotic-assisted surgery for benign and malignant gynecologic diseases in the United States exceeds that of urological surgery. Currently, other types of robot-assisted devices are being developed, and the number of robot-assisted surgeries is expected to increase in the near future.

At our hospital, we first began using robot-assisted surgery for early-stage uterine corpus cancer in November 2018 and have since performed 40 operations. This study aimed to assess the learning curve, complications and outcomes of robot-assisted surgery.

2. Materials and Methods

We performed 40 cases of robot-assisted surgery for early-stage uterine corpus cancer from 01 November 2018, to 31 December 2021. Written consent was obtained from all patients who underwent surgery, and opt-out for the retrospective study was posted on the Oita University website. Five cases were excluded because they underwent additional operations, including colporrhaphy or did not undergo lymphadenectomy. The same operator, a specialist in gynecological laparoscopic surgery, performed all robot-assisted operations. The operator has conducted over 500 gynecological laparoscopic surgeries for myoma uteri, ovarian tumors, ectopic pregnancies, and uterine cervical and corpus cancers.

Before the robot-assisted surgery, all patients were assessed for the absence of glaucoma, cerebral aneurysms, and other complications that might have negative indications for robot-assisted surgery. We did not impose surgical restrictions on

patients with high BMI.

We used the Da Vinci surgical system (Intuitive Surgical System USA) for robot-assisted operations. The patients were placed in the lithotomy position, with the head in the lower position by 15 to 20 degrees. Five ports were created in the upper abdomen. The center port was used as the camera port, three for the robot arms, and the remaining one was for the assistant physician. This study did not use a uterine manipulator, usually used in gynecologic benign laparoscopic surgery, to avoid the risk of uterine perforation and tumor dissemination.

We determined the differences in operative duration, amount of bleeding, and the number of resected lymph nodes between the first 20 patients and the latter 15 patients, as well as between obese and non-obese patients. The *t*-test was employed for statistical analyses.

3. Results

The 40 cases were pre-operatively diagnosed with stage IA uterine corpus cancer based on computed tomography scan and magnetic resonance imaging (MRI), and G1 or G2 of the uterine corpus cancer. The patients' baseline data are shown in Table 1. They had an average age of 57 years and an average body mass index (BMI) of 25 (Table 1). Since obesity is one of the risk factors for uterine corpus cancer, the patients in this study tended to have a higher BMI than average female Japanese patients.

Of the 40 patients, 36 were classified as stage IA based on the International Federation of Gynecology and Obstetrics (FIGO), 2 as stage IB, and 2 with lymph-node metastasis as stage IIIC1. The latter 4 received 6 courses of chemotherapy using paclitaxel and carboplatin. Three elderly patients without lymph node dissection and two with pelvic organ prolapse who underwent vaginoplasty were excluded from further analysis.

Fig. 1 shows the total operation time, console time, and blood loss during the operation in 35 cases. Fig. 2 shows the comparison in operation time and amount of blood loss between the first 20 and the following 15 surgeries in our hospital. It could be observed that the surgeon's skills significantly improved after the first 20 cases of surgery. Additionally, there was no significant difference in the number of removed lymph nodes between the first 20 cases and the latter 15 cases (data not shown). Further, no difference was observed in operation time and blood loss between the obese (BMI $\geq$30) and non-obese patients (Fig. 3).

In regard to surgery-related complications, 6 patients had infections (urinary tract infection (n = 4) and peritonitis (n = 2)), 1 had subcutaneous emphysema, and 1 had vaginal dehiscence. There were no cases of conversion from robot-assisted surgery to open surgery. All complications except subcutaneous emphysema occurred in the first 20 cases. The first 20 patients received a ureteral stent, which might have contributed to the higher frequency of urinary tract infections. No serious life-threatening complications were observed. In one patient, a vaginal stump recurrence was detected after surgery and was treated with additional chemotherapy.

TABLE 1. The characteristics of the patients assessed in this study.

Patient characteristics (n = 40)	
Age (mean (SD))	57 (13)
BMI (mean (SD))	25 (5)
Total operation time (mean(SD))	273 (45)
Console time (mean (SD))	209 (47)
Blood loss (mean (SD))	108 (114)
The number of resected lymph nodes	25 (10)
Pathology	
endometrioid adenocarcinoma	39
mucinous carcinoma	1
Pathological stage	
IA	36
IB	2
IIIC1	2
complication infection	
peritonitis	2
urinary infection	3
subcutaneous emphysema	1
dehiscence of vaginal stump	1
recurrence	1

BMI: body mass index; SD: standard deviation.

4. Discussion

In the past, open surgery was routinely performed for gynecologic malignancies, and with developments in minimally in MIS, laparoscopic surgery is now indicated for early-stage uterine cancer, shifting the operative method from laparoscopic surgery to robot-assisted surgery. Robot-assisted surgery was first commonly used for prostate cancer, which requires a delicate procedure and a deep field of view, and is now widely used in the respiratory, cardiovascular, gastrointestinal and gynecological fields. Robot-assisted surgery is very important for gynecologic malignancies because, like prostate cancer surgery, it requires delicate deep-field techniques and good visualization. Moreover, robot-assisted surgery is also indicated for benign uterine myoma, and in the United States, the gynecological department comprised the largest number of robot-assisted surgery [3, 4].

Some papers have reported that the learning curve for robot-assisted surgery requires 20 to 30 cases for significant improvement in many departments, including gynecology and urology [5–7]. On the other hand, Hwang *et al.* [8] and Chong *et al.* [9] reported that the learning curve for laparoscopic surgery for gynecologic malignancies is generally 35 and 50 cases, respectively. Flynn *et al.* [10] studied the learning curve for laparoscopic cholecystectomy and robotic-assisted cholecystectomy and reported that robotic-assisted cholecystectomy had a faster learning curve. Similarly, Goh *et al.* [11] reported that robot-assisted surgery for periampullary tumors has a faster learning curve than laparoscopic surgery. In this

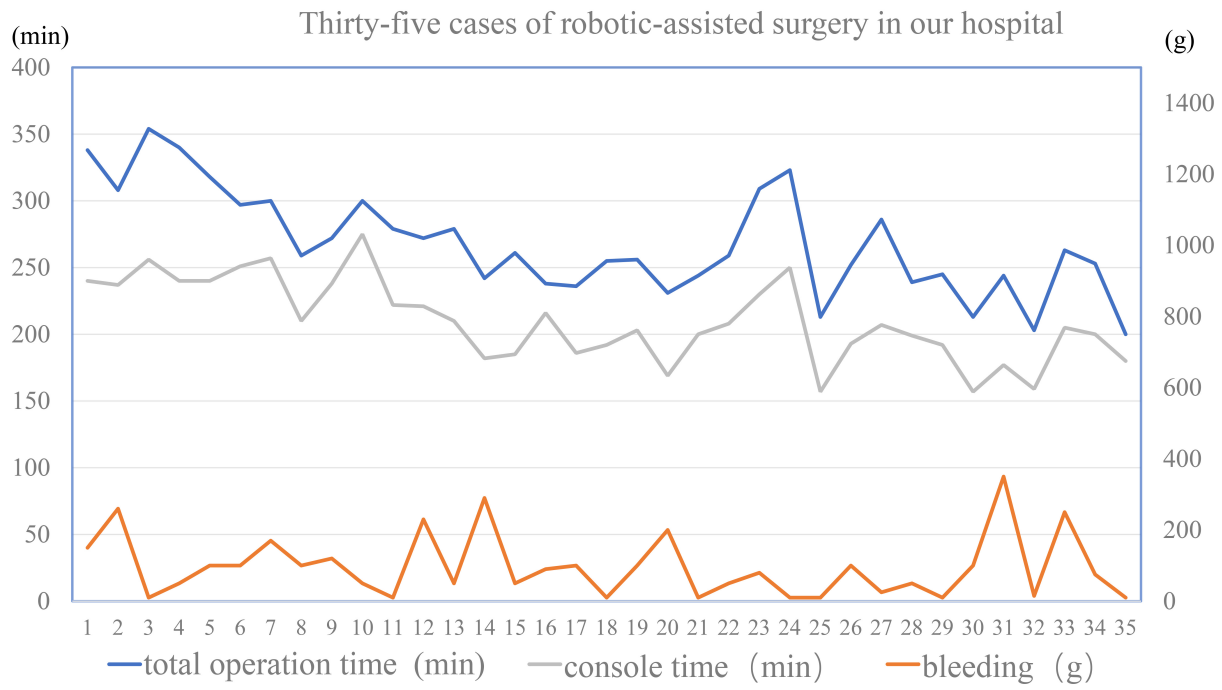

FIGURE 1. Total operative time, console time and blood loss in 35 patients undergoing robot-assisted surgery for uterine corpus cancer in our hospital.

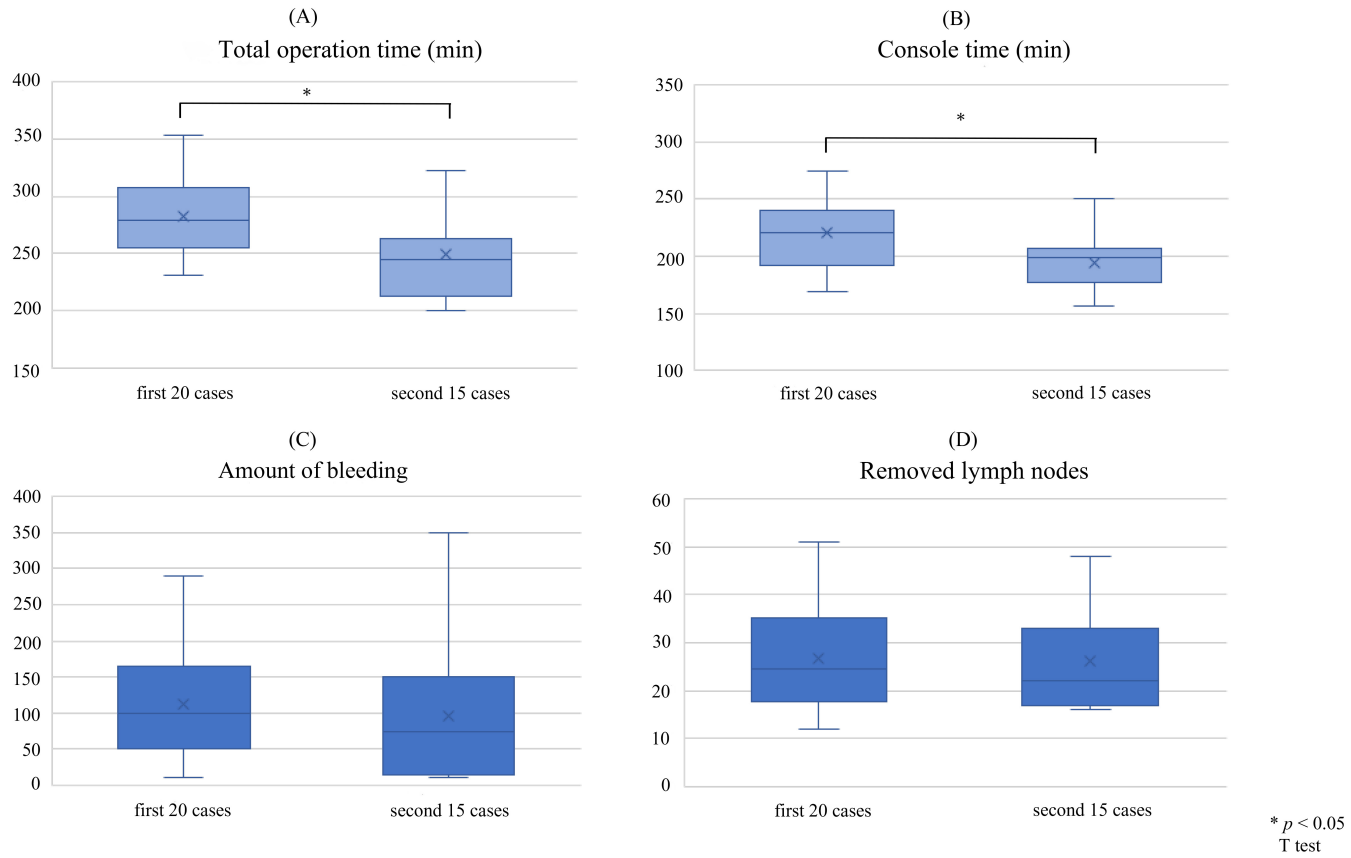

FIGURE 2. Comparison of early and late cases. Comparison of total operative time (A), console time (B), blood loss (C), and the number of lymph nodes removed (D) between the first 20 and following 15 uterine corpus cancer operations using robot-assisted technology in our hospital. There were statistically significant differences between the first 20 cases and the following 15 cases in operation and console time.

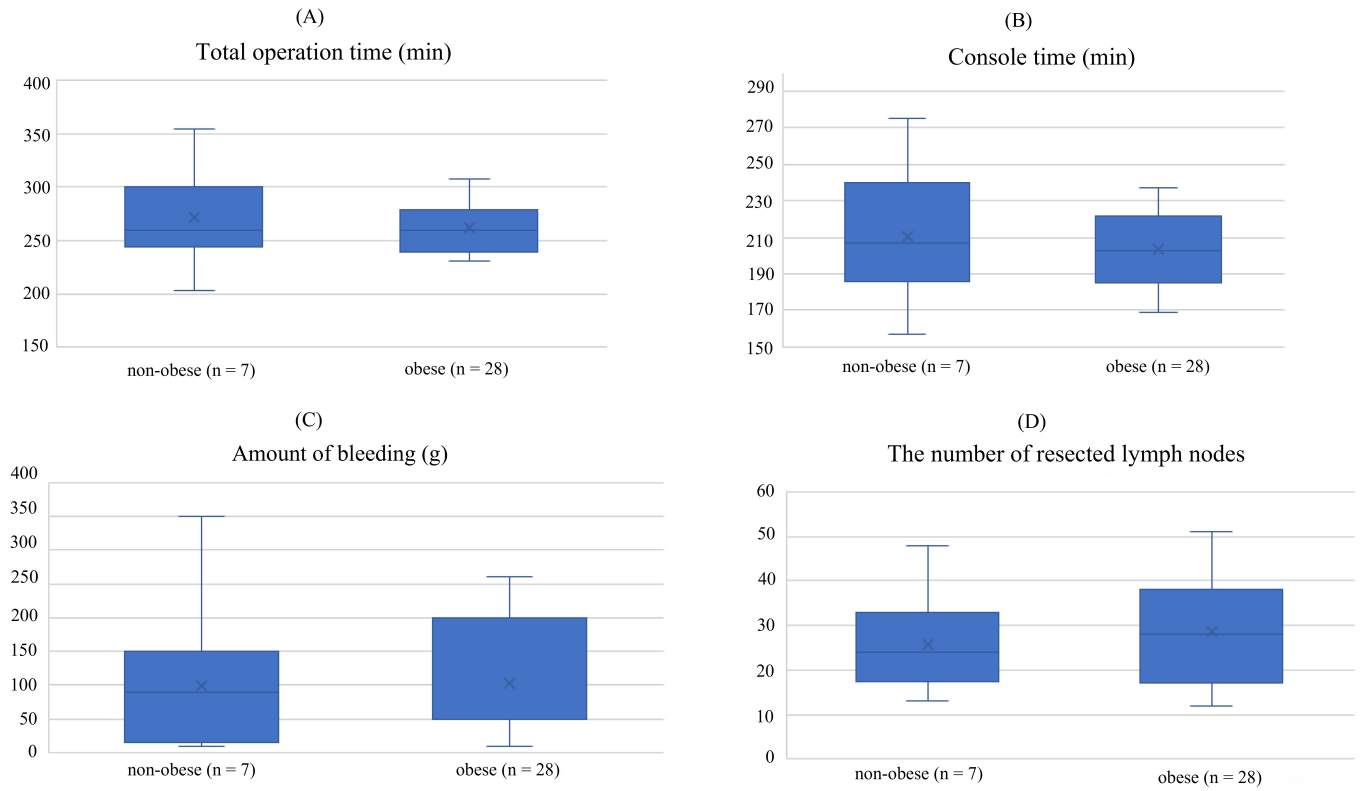

FIGURE 3. Comparison of obese and non-obese cases. Comparison of total operative time (A), console time (B), blood loss (C), and the number of lymph nodes removed (D) between obese and non-obese patients undergoing robot-assisted surgery for uterine corpus cancer in our hospital. There were no statically significant differences between obese (BMI $\geq$30) and non-obese (BMI $<$30) patients.

present study, although the total operation time and console time of robot-assisted procedures significantly decreased after the first 20 cases, we did not find any significant differences in the amount of blood loss and the number of removed lymph nodes between the former 20 and later 15 cases, which we believe might be related to the ample experience of the operator with laparoscopic surgery. The significant difference in operation time and console time could be attributed to the time taken for the surgeons to become accustomed to preparing robotic equipment for use. Gungorduk *et al.* [12] studied the improvements in robot-assisted hysterectomy by residents and concluded that the improvements in the technique of robot-assisted surgery problems earlier in the resident group who had experienced laparoscopic surgery compared with another resident group without those experiences.

Obesity is one of the factors complicating cancer surgery due to the obstruction of surgical view by adipose tissues, especially for open surgeries. The implementation of robot-assisted surgery was found to overcome this issue in obese patients because it does not require as much force to operate forceps or secure visual fields [4, 5]. Another study reported that in obese patients, robot-assisted surgery was associated with a significantly reduced operating time and blood loss, increased number of lymph nodes removed and decreased hospital stay compared with open surgery [4]. Peacock *et al.* [13] reported that in obese patients with lower rectal cancer, robot-assisted surgery was also beneficial in reducing blood loss and the incidence of several complications compared with open surgery. Contrastingly, Gracia *et al.* [14] reported that robot-assisted surgery might not be advantageous for obese patients because they observed that a BMI above 30 increased hospital stay by an average of two days and that patients with a BMI below 25 had significantly more blood loss than those with a BMI of 30. However, our results showed that the amount of bleeding and operation time was not significantly prolonged in obese patients with over 30 BMI and there was no increase in complications in obese patients. Improvements of operation techniques might help surgeons to overcome the challenges of surgery in obese patients.

Complications associated with robot-assisted surgery are less frequent compared with open or laparoscopic surgery due to shorter hospital stays and less blood loss [13, 15]. In this present study, postoperative infection, including urinary tract infection and peritonitis, was the most common complication and was more frequent in the first 20 patients. A probable reason for this observation could be related to the insertion of a W-J catheter in the first 20 patients. However, it could also be related to the surgeon's familiarity with the technique, as it was demonstrated that complications tended to be more prevalent when a new technique is first implemented, regardless of whether it is robot-assisted surgery or other approaches [4]. Hence, improvement in the operation technique might be associated with decreased complications. Giannini *et al.* [16] reported their findings on a modified

fragility index (mFI) in endometrial cancer, which quantifies 11 variables comprising diabetes mellitus, functional status index >2, chronic obstructive pulmonary disease or pneumonia, congestive heart failure, myocardial infarction, percutaneous coronary intervention and/or stenting or angina, hypertension requiring medication, peripheral vascular disease or ischemic rest pain, impaired sensorium, transient ischemic attack or cerebrovascular accident, and cerebrovascular accident with a deficit in endometrioid uterine cancer. They found that obese patients (BMI >40) or those with an mFI >3 had a significantly higher risk of severe complications. Comparatively, 2 patients had a BMI >40, but no patient had an mFI ≥3 in our study, which might partly explain the lack of serious complications.

In this study, the learning curve for robot-assisted surgery for uterine cancer was improved in 20 cases, and robot-assisted surgery was shown to be useful in obese patients. The limitation of this study is that data for a single surgeon is not yet sufficient for generalization. But surgeons familiar with laparoscopic surgery are expected to learn robot-assisted surgery quickly. Because minimally invasive surgery will increase in the future, surgeons will need to become familiar with robot-assisted surgeries and traverse the learning curve for each new technique.

AUTHOR CONTRIBUTIONS

MN and YK—designed the research study; MN—performed all the surgery as the surgeon; KN, KK, MY, and YK—assisted with the operation; MN and YK—analyzed the data; MN—wrote the manuscript. All authors read and approved the final manuscript.

ETHICS APPROVAL AND CONSENT TO PARTICIPATE

This research was approved by the Ethics Committee of Oita University (No. 2272). The patients provided informed consent and agreed to publication of the details of this research.

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CONFLICT OF INTEREST

The authors declare no conflict of interest. Kaei Nasu is serving as one of the Editorial Board members of this journal. We declare that Kaei Nasu had no involvement in the peer review of this article and has no access to information regarding its peer review. Full responsibility for the editorial process for this article was delegated to YA.

REFERENCES

[1] Walker JL, Piedmonte MR, Spirtos NM, Eisenkop SM, Schlaerth JB, Mannel RS, *et al*. Laparoscopy compared with laparotomy for comprehensive surgical staging of uterine cancer: gynecologic oncology group study LAP2. Journal of Clinical Oncology. 2009; 27: 5331–5336.

[2] Gokmen Karasu AF, Kıran G, Şanlıkan F. Intraoperative complications and conversion to laparotomy in gynecologic robotic surgery. Journal of Investigative Surgery. 2022; 35: 912–915.

[3] Li Y, Kong Q, Wei H, Wang Y. Comparison of the complications between minimally invasive surgery and open surgical treatments for early-stage cervical cancer: a systematic review and meta-analysis. PLoS One. 2021; 16: e0253143.

[4] Clair KH, Tewari KS. Robotic surgery for gynecological cancers; indications, techniques, and controversies. Journal of Obstetrics and Gynaecology Research. 2020; 46: 828–843.

[5] Sofer A, Magnezi R, Eitan R, Raban O, Tal O, Smorgic N, *et al*. Robotic *vs.* open surgery in obese women with low-grade endometrial cancer: comparison of costs and quality of life measures. Israel Journal of Health Policy Research. 2020; 9: 60.

[6] Turner TB, Kim KH. Mapping the Robotic hysterectomy learning curve and re-establishing surgical training metrics. Journal of Gynecologic Oncology. 2021; 32: e58.

[7] Akazawa M, Hashimoto K, Lee SL, Liu WM. Learning curve of robot-assisted hysterectomy with pelvic lymphadenectomy for early-stage endometrial cancer: analysis of 81 cases. Anticancer Research. 2021; 41: 4173–4178.

[8] Flynn J, Larach JT, Kong JCH, Waters PS, Warrier SK, Heriot A. The learning curve in robotic colorectal surgery compared with laparoscopic colorectal surgery: a systematic review. Colorectal Disease. 2021; 23: 2806–2820.

[9] Goh BKP, Low T, Kam J, Lee S, Chan CY. Initial experience with laparoscopic and robotic surgery for the treatment of periampullary tumours: single institution experience with the first 30 consecutive cases. ANZ Journal of Surgery. 2019; 89: E137–E141.

[10] Hwang JH, Yoo HJ, Joo J, Kim S, Lim MC, Song YJ, *et al*. Learning curve analysis of laparoscopic radical hysterectomy and lymph node dissection in early cervical cancer. European Journal of Obstetrics & Gynecology and Reproductive Biology. 2012; 163: 219–223.

[11] Chong GO, Park NY, Hong DG, Cho YL, Park IS, Lee YS. Learning curve of laparoscopic radical hysterectomy with pelvic and/or para-aortic lymphadenectomy in the early and locally advanced cervical cancer. International Journal of Gynecological Cancer. 2009; 19: 1459–1464.

[12] Gungorduk K, Kahramanoglu O, Ozdemir IA, Kahramanoglu I. Robotic platforms for endometrial cancer treatment: review of the literature. Minerva Medica. 2021; 112: 47–54.

[13] Peacock O, Limvorapitak T, Hu CY, Bednarski BK, Tillman MM, Kaur H, *et al*. Robotic rectal cancer surgery: comparative study of the impact of obesity on early outcomes. British Journal of Surgery. 2020; 107: 1552–1557.

[14] Gracia M, García-Santos J, Ramirez M, Bellón M, Herraiz MA, Coronado PJ. Value of robotic surgery in endometrial cancer by body mass index. International Journal of Gynecology & Obstetrics. 2020; 150: 398–405.

[15] Bourgin C, Lambaudie E, Houvenaeghel G, Foucher F, Levêque J, Lavoué V. Impact of age on surgical staging and approaches (laparotomy, laparoscopy and robotic surgery) in endometrial cancer management. European Journal of Surgical Oncology. 2017; 43: 703–709.

[16] Giannini A, Di Donato V, Schiavi MC, May J, Panici PB, Congiu MA. Predictors of postoperative overall and severe complications after surgical treatment for endometrial cancer: the role of the fragility index. International Journal of Gynecology & Obstetrics. 2020; 148: 174–180.

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