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ARAŞTIRMA / RESEARCH

Robotic or laparoscopic approach for hysterectomy: comparison of operative outcomes and cost

Histerektomide robotik veya laparoskopik yaklaşım: operatif sonuçlar ve maliyet karşılaştırılması

Sema Karakaş[1], Gökhan Demirayak[1], Şakir Volkan Erdoğan[2], Aliye Erdoğan[1], Ayşe Büşra Önder[1], İsa Aykut Özdemir[3], Cihan Comba[4], Sema Süzen Çaypınar[5], Murat Ekin[1], Levent Yaşar[1], Selim Avşar[1]

[1]University of Health Sciences, Bakirkoy Dr Sadi Konuk Training and Research Hospital, Department of Gynecologic Oncology, Istanbul, Turkey
[2]University of Health Sciences, Bağcılar Training and Research Hospital, Department of Gynecology and Obstetrics, Istanbul, Turkey
[3] Istanbul Medipol University, Department of Gynecologic Oncology, Istanbul, Turkey
[4]University of Health Sciences, Haseki Training and Research Hospital, Department of Gynecology and Obstetrics, Istanbul, Turkey
[5]University of Health Sciences, Cam and Sakura City Hospital, Department of Gynecology and Obstetrics, Istanbul, Turkey

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Abstract

Purpose: The present study aimed to compare surgical outcomes and cost analysis of robotic-assisted surgery (RAS) and conventional laparoscopic surgery (CLS) hysterectomy procedures.

Materials and Methods: The patients who underwent total robotic hysterectomy or total conventional laparoscopic hysterectomy with or without bilateral salpingo-oophorectomy due to benign gynecological disorders such as uterine fibroid, abnormal uterine bleeding, endometrial hyperplasia, adenomyosis, persistent ovarian cysts, chronic pelvic pain were retrospectively evaluated.

Results: A total of 80 women underwent RAS or CLS hysterectomy during the study period. The mean total operative time was 187 ±10 min. in RAS and 133 ±24 min. in CLS groups, respectively. The mean total cost of the RAS hysterectomy group was 17.710 TL, and CLS hysterectomy group was 7000 TL.

Conclusion: Both CLS and RAS hysterectomies for benign gynecological indications are safe surgical procedures with negligible complication rates. RAS is a more expensive procedure compared to CLS.

Keywords: Hysterectomy, gynecology, robot-enhanced surgery, laparoscopy

Öz

Amaç: Bu çalışma, robotik yardımlı cerrahi (RAC) ve geleneksel laparoskopik cerrahi (GLC) histerektomi prosedürlerinin cerrahi sonuçlarını ve maliyet analizini karşılaştırmayı amaçlamaktadır.

Gereç ve Yöntem: Uterin fibroid, anormal uterin kanama, endometrial hiperplazi, adenomiyozis, persiste eden over kistleri, kronik pelvik ağrı gibi benign jinekolojik bozukluklar nedeniyle bilateral salpingo-ooferektomi ile birlikte veya salpingo-ooferektomi olmaksızın total robotik histerektomi veya total konvansiyonel laparoskopik histerektomi uygulanan hastalar geriye dönük olarak değerlendirildi.

Bulgular: Çalışma dönemi sırasında toplam 80 kadına RAC veya GLC histerektomi yapıldı. Ortalama toplam ameliyat süresi RAC ve GLC gruplarında sırasıyla 187 ± 10 dk. ve 133 ± 24 dk. idi . RAC histerektomi grubunun ortalama toplam maliyeti 17.710 TL ve GLC histerektomi grubunun 7000 TL idi.

Sonuç: İyi huylu jinekolojik endikasyonlar için hem GLC hem de RAC histerektomiler ihmal edilebilir komplikasyon oranları ile güvenli cerrahi prosedürlerdir. Maliyetlerle ilgili olarak, RAC, GLC 'ye göre daha pahalı bir prosedürdür.

Anahtar kelimeler: Histerektomi, jinekoloji, robot destekli cerrahi, laparoskopi

Yazışma Adresi/Address for Correspondence: Dr. Sema Karakaş, University of Health Sciences, Bakirkoy Dr Sadi Konuk Training and Research Hospital, Department of Gynecologic Oncology, Istanbul, Turkey E-mail: semaakyildiz@hotmail.com
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INTRODUCTION

Although conventional laparoscopic surgery (CLS) allows more convenient recovery and has better cosmetic outcomes than laparotomy, CLS has a few technical drawbacks, such as restricted range of motion of instruments and dexterity loss, unstable camera view, and a 2 dimension (2D) visualization of the operation field[1-3].

Robotic-assisted surgery (RAS) is an alternative to CLS with lower reported conversion to laparotomy rates, better ergonomic improvements for the surgeons, 3 dimension (3D) visualization of the surgery field, and a stable camera view[4,5]. On the contrary, RAS has some drawbacks, such as the higher costs of the robotic instruments and the presence of a limited number of robotic platforms. The expenditures fort he RAS include the purchase of the robot itself, the annual maintenance costs, and the cost of instruments per-case[6]. The studies comparing gynecological surgical outcomes and cost analysis of RAS and CLS such as hysterectomy have been inconclusive so far. Some studies have demonstrated robotic hysterectomy to be associated with shorter hospital stay and better postoperative pain profile, while the others have demonstrated equivalence to the laparoscopic approach[7,8].

The present study aimed to compare surgical outcomes and cost analysis of RAS and CLS hysterectomy procedures.

MATERIALS AND METHODS

The patients who underwent total RAS hysterectomy or total CLS hysterectomy with or without bilateral salpingo-oophorectomy between March 2014 and October 2018 in a high-volume tertiary referral tranining and research hospital due to benign gynecological disorders such as uterine fibroid, abnormal uterine bleeding, endometrial hyperplasia, adenomyosis, persistent ovarian cysts, chronic pelvic pain were retrospectively evaluated. Forty consecutive age-matched women who underwent CLS were included in the laparoscopic hysterectomy group. The RAS hysterectomy group also comprised of 40 patients. The study was approved by University of Health Sciences, Bakirkoy Dr Sadi Konuk Hospital's local ethics committee (2019/17/02) and was conducted following the ethical principles described by the Declaration of Helsinki.

The inclusion criteria were as follows: (1) age≥18 years; (2) patients who underwent a RAS or CLS hysterectomy with or without salpingo-oophorectomy for benign gynecological diseases such as uterine fibroid, heavy menstrual bleeding, endometrial hyperplasia, adenomyosis, persistent ovarian cysts, and chronic pelvic pain. The exclusion criteria were as follows: (1) the presence of extensive concurrent surgical procedures such as prolapse surgery or lymph node dissection (2) the hysterectomies performed other than three surgeons, namely IAO, LY, ME, who passed their initial learning curve (greater than or equal to 30 previous RAS or CLS hysterectomy cases). All patients' data meeting inclusion criteria were included. The decision to perform CLS or robotic surgery was depend on the surgeon's preference.

Surgical procedures

CLS

In our center, the procedure was initiated after achieving an adequate pneumoperitoneum. A 10 mm intra-umbilical trocar was then inserted for optic visualization, and three 5 mm accessory trocars were used for the instruments. A standard 10 mm rigid 30^0 scope (Karl Storz, Tuttlingen, Germany) was used. A Clermont-Ferrand manipulator (Karl Storz, Tuttlingen, Germany) preferred uterine manipulation and facilitated colpotomy. The procedure then begins with the following steps; sealing and cutting round ligaments, uterine arteries, and cardinal ligaments in consecutive order from cranially to caudally using a conventional laparoscopic grasping forceps and a 5 mm LigaSure sealing device (Medtronic, Dublin, Ireland). The uterus with or without adnexa was removed through the colpotomy opening. The vaginal cuff was then sutured with a 3-0 15 mm barbed V-Loc suture (Medtronic, Minneapolis, MN).

RAS

In our center, the surgery was initiated after docking of the da Vinci Xi system (Intuitive Surgical, Sunnyvale, CA). After achieving an adequate pneumoperitoneum. A 10 mm intra-umbilical trocar was then inserted for optic visualization, and three 5 mm accessory trocars were used for the robotic instruments. A 10 mm assistant port was used for suction/irrigation when needed. A standard 10 mm rigid 30^0 scope was used. A Clermont-Ferrand manipulator (Karl Storz, Tuttlingen, Germany) was

preferred for uterine manipulation. The surgical steps then followed as in CLS.

The primary outcomes were complication rate, transfusion rate, total operative time, and hospital stay. The secondary outcome was the total direct cost of patient hospitalization related to hysterectomy. Direct costs were calculated by the hospital's accounting department and are defined as the actual cost of total hospital care. This included operating room reusable and disposable instrument costs, medical therapy, labor cost, and laboratory costs. The da Vinci XI robot's acquisition and maintenance costs were calculated for in the operating room reusable instrument costs. The other reusable devices included trocars, grasping forceps, and scissors.

Data obtained from the medical records included: age, body mass index (BMI), prior mode of delivery, the presence of salpingectomy or salpingo-oophorectomy, conversion to laparotomy, uterine weight, operative time, a decrease of hemoglobin level, transfusion requirement, and length of hospital stay. Operative time was recorded from skin incision to skin closure, which excludes the time needed to set-up the robot but includes its docking. Perioperative morbidities were divided into intraoperative complications, such as inadvertent lacerations of the bowel, bladder, and ureter, and postoperative complications, which involved fever and sepsis, transfusion, venous thromboembolism, urinary retention, respiratory failure, pneumonia, ileus, wound infection, seroma, and hematoma.

Statistical analysis

The statistical analysis was performed using the SPSS 22.0 software (IBM Corp., Armonk, NY, USA). Descriptive data were presented in mean and standard deviation (SD), median (min-max) values, number (n), and frequency (%). The Kolmogorov-Smirnov test was used to analyze the normality of data distribution. Independent sample t-test was used to compare age, BMI, parity, number of deliveries, and surgical outcomes between the study groups. Mann-Whitney U test was used to evalute total costs between the study groups. The chi-square test was used to investigate independent qualitative data. A p-value of 0.05 was considered statistically significant.

RESULTS

A total of 80 women underwent RAS or CLS hysterectomy during the study period. The demographic features of the RAS and CLS groups are shown in Table 1. The mean age of the patients was 50.2±8.3 years in the RAS group and 48.8±5.8 in the CLS group (p:0.38). The mean body-mass index were 31.9±3.7 kg/m2 and 33.6 ±4.7, respectively (p: 0,07).

The mean total operative time was 187 ±10 min. in RAS and 133 ±24 min. in CLS groups, respectively (p<0,001). The mean uterine weight was 251.34±138 gr. in the RAS group and 257.38±127 gr. in the CLS group (p:0,82). The mean difference between the pre- and postoperative hemoglobin values were 1.5±0.9 g/dl in RAS and 1,3±1.1 g/dl in CLS groups, respectively (p:0.34).

The mean hospital stay was 2±0.45 and 2.3± 1.9 days, respectively (p: 0,63). No additional port insertion or and no conversion to laparotomy was needed in both study groups. The median follow-up time was 12 months in both groups. There was no cuff dehiscence in neither RAS nor CLS group. The operative outcomes were shown in Table 2.

The mean total cost of the RAS hysterectomy group was 17.710 TL, and the mean total cost of the CLS hysterectomy group was 7000 TL. The detailed hospital costs were shown in Table 3.

Table 1. The demographic features of the RAS and CLS groups.

	RAL (n:40) mean±SD	**CLS (n:40) mean±SD**	***p* value**
Age (years)	50.2±8.3	48.8±5.8	0.38
BMI (kg/m^2)	31.9±3.7	33.6±4.7	0.07
Parity	2.3±1.1	2.8±1.6	0.10
Vaginal delivery	1.9±1.2	2.1±1.8	0.56
Cesarean section	0.7±0.37	0.65±0.89	0.74

BMI:Body mass index; RAS:Robotic assisted surgery; CLS:Conventional laparoscopic surgery

Table 2. The surgical outcomes of the RAS and CLS groups.

		RAL (n:40) mean±SD	CLS (n:40) mean±SD	*p* value
Hb Difference (g/dL)		1.5±.0.9	1.3±1.1	0.343
Pre-operative Hb (g/dL)		11.72±1.61	12.3±1.62	0.07
Post-operative Hb (g/dL)		10.12±1.48	10.75±1.37	0.06
Operation time (min.)		187.10 ±71	133±24	**<0.001**
Uterine weight (gr)		251.34±138	257.38±127	0.82
Salpingo-oophorectomy	No (n/%)	5(12.5%)	11(27.5%)	0.161
	Yes (n/%)	35(87.5%)	29(72.5%)	
Duration of hospital stay (days)		2±0.45	2.3± 1.9	0.631
Blood transfusion requirement	No(n/%)	38(95%)	39(97.5%)	N/A
	Yes (n/%)	2(5%)	1(2.5%)	
Complication (n)	No (n/%)	38(95%)	39(97.5%)	N/A
	Yes (n/%)	2(5%)	1(2.5%)	

Table 3. The cost analysis of the RAS and CLS groups.

	RAL (n:40) median (min-max)	CLS (n:40) median (min-max)
OR room reusable instrument costs (TL) (	13.251 (11.350-14.453)	130 (108-143)
OR disposable instrument costs (TL)	499 (356-611)	2.898 (2560-3001)
Laboratory costs (TL)	59 (40-78)	52(24-80)
Medical treatment costs (TL)	101 (60-143)	120(74-166)
Other (OR Surgeon/stuff/hospitalization) (TL)	3800	3800
Total (TL)	17.710	7000

OR:Operation room

DISCUSSION

In the last two decades, the introduction of robotic surgery has generated a huge excitement. However, its clinical benefits over the CLS remains unclear[9,10] . The results of previous reviews regarding the efficacy of RAS over CLS or laparotomy concluded that RAS hysterectomy for benign gynecological cases demonstrates noticeable improvements compared to laparotomy. Still, comparable results were observed in the laparoscopic technique when it comes to considering surgical outcomes[9,10] .

In a meta-analysis covering 326 participants from 4 randomized trials reported similar rates of perioperative complications. Besides, no meaningful differences were observed between RAS and CLS techniques regarding postoperative pain symptoms and quality of life scores[11]. However, significant heterogeneity was reported in the studies included in this meta-analysis considering all these variables[11]. In another meta-analysis evaluating the patients who underwent only total hysterectomy or total hysterectomy with lymph node dissection, the RAS group had better surgical outcomes than the CLS procedure[12]. This could indicate that the RAS could be more feasible in greater surgical complexity cases, such as gynecology oncology cases[12].

In a study by Martínez-Maestre et al., the shorter surgical times were observed in the RAS group compared to the CLS group[13] . On the contrary, various studies reported a tendency toward longer operation times for RAS hysterectomy than CLS

(89.9-267 minutes for RAS and 83-206 minutes for CLS)[14]. In our study, we observed a significantly longer surgery time in the RAS group compared to the CLS group. The longer surgery time in the RAS group could be associated with docking and undocking procedure of the robotic platform.

Ngan et al. reported that the length of hospital stay and conversion rates to laparotomy were comparable with CLS hysterectomy cases[14]. Overall, patients from both study cohorts had short lengths of hospital stay as around two days. There was no significant difference between the study groups regarding hospital stay in our study, and no conversion was needed in both groups[14]. According to our results, in line with the literature, shorter hospital stay could be associated with less postoperative pain and faster recovery that observed in both approaches, which are the advantages of minimally invasive surgery.

Regarding the transfusion rate, a greater proportion was observed in the laparoscopic group compared to the RAS group. The other studies also confirmed that the RAS group patients had less transfusion rate than CLS either for benign or malignant gynecological diseases[15]. They concluded that RAS provides easier hemostasis by articulating electrocautery, meticulous precision of robotic instruments, a 3D vision of the robot, and the tremble-free robotic arms. However, in our study, no significant difference was observed between the study groups regarding the transfusion rate or hemoglobin decrease between the study groups. We may speculate that a similar decrease in hemoglobin levels and transfusion rates could be associated with delicate surgical skills of the surgical team.

Another issue that affects the adaptation and feasibility of a technique is complication rates. In a high-volume study by Ngan et al., similar complication rates were reported in both CLS (n:33088) and RAS (n:10677) cohorts[14]. Regarding the short and long-term complication rates of hysterectomies, RAS was associated with higher ileus rates and fewer. Ngan et al. reported that these findings could be attributed to longer operating times in the Trendelenburg position[14]. Besides, in another study, robotic port site hernias were found to be higher through 8-mm robotic port sites which cause higher morbidity rates and longer hospital stay[16]. In our study, two patients in the RAS group had a complication in the postoperative first week that one patient had a cuff hematoma, and the other had a vesicovaginal fistula, which was managed by a JJ stent. One patient with previous cesarean sections in the CLS group had intraoperative cystotomy and managed by intraoperative double-layer suturing.

The major issue to consider is the cost of RAS, which could be less affordable to patients with lower incomes[17,18]. Despite similar clinical and surgical outcomes, RAS hysterectomy cases remained significantly more costly, considering the median in-hospital charges. Up to now, two studies have addressed the cost issue by comparing the difference in costs between RAS and CLS in hysterectomy cases[17,18]. Robotic hysterectomy is indeed expensive and costs an average of US$2631 to US$2667 more than a CLS. The higher costs could be attributed to expenditures for robotic instruments that have a limited number of lives[19]. Besides, it's expensive acquisition and maintenance fee also increase the costs[19]. In our study, the mean in-hospital cost for RAS was also significantly higher compared to CLS. These higher costs are mainly due to robotic instruments since there was no significant difference between medication and laboratory costs.

The limitations of our study could be its retrospective design and small sample size. Despite the limitations of our study, we presented our experience depicting in a typical tertiary referral hospital in our national health care system, which is almost publicly funded, to resemble our insurance policy by comparing RAS and CLS hysterectomy for benign gynecological indications. The strength of our study is the same surgical team was involved in the surgeries, and a standardized RAS or CLS protocols were carried out.

In conclusion, both CLS and RAS hysterectomies for benign gynecological indications are safe surgical procedures with negligible complication rates. Regarding the costs, RAS is a more expensive procedure compared to CLS. However, the cost and the length of hospital stay could not be generalized due to the standards that vary by country, hospital protocols, surgical training, health insurance, and cultural and societal attitudes that play a role in discharge timing.

Yazar Katkıları: Çalışma konsepti/Tasarımı: SK, GD, AE, ABÖ; Veri toplama: -; Veri analizi ve yorumlama: -; Yazı taslağı: SK, GD, AE, ABÖ; İçeriğin eleştirel incelenmesi: İAÖ; Son onay ve sorumluluk: SK, GD, ŞVE, AE, İAÖ, ABÖ; Teknik ve malzeme desteği: GD; Süpervizyon: ŞVE; Fon sağlama (mevcut ise): yok.
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