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Original Article

Laparoscopic vs. open surgery for early-stage endometrial cancer: effect on inflammatory factors and quality of life

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Abstract: Objective: To evaluate the differential effects of laparoscopic versus open surgery on inflammatory factors and quality of life (QoL) in patients with early-stage endometrial cancer (EEC). Methods: A total of 165 eligible EEC patients treated between January 2023 and June 2025 were enrolled and stratified according to surgical schemes into a control group (n=80; open surgery) and a research group (n=85; laparoscopic surgery). Comparative analyses were conducted across multiple domains, including therapeutic efficacy, safety outcome (e.g., incision infection, intestinal injury, ureteral injury, lower-limb deep venous thrombosis, and urinary retention), surgical indicators (intraoperative blood loss, operation time, lymph node yield), postoperative recovery (time to intestinal function recovery, duration of bed rest, and length of hospital stay), bladder function (time to first spontaneous urination, post-void residual urine volume, and time to complete micturition recovery), urodynamic function (free flow rate [FFR], filling-phase bladder pressure, and pressure-flow study during voiding), inflammatory factors (serum interleukin [IL]-6, tumor necrosis factor [TNF]-α, high-sensitivity-C reactive protein [hs-CRP]), and quality of life (QoL) assessed using the 36-Item Short-Form Health Survey [SF-36]). Results: The research group achieved an evidently higher overall response rate compared to the control group, with a lower incidence of postoperative complications, less intraoperative bleeding, reduced operation time, and more lymph nodes retrieved. Postoperative recovery was significantly improved in the research group, as evidenced by shorter time to intestinal function recovery, reduced bed rest duration, and shorter hospital stay. Bladder function recovery was also superior, with shorter time to first spontaneous urination and complete micturition recovery, as well as lower post-void residual urine volume. Regarding urodynamic outcomes, although FFR, filling phase bladder pressure, and pressure-flow indicators decreased postoperatively in both groups, these indicators remained significantly higher in the research group than in the control group. Moreover, postoperative levels of IL-6, TNF-α, and hs-CRP were markedly reduced in both group, with significantly lower levels in the research group. QoL assessment revealed significantly higher SF-36 scores in domains of role-emotional, social functioning, physical functioning, and general health in the research group compared to the control group. Conclusion: Laparoscopic surgery outperforms open surgery for EEC treatment, significantly inhibiting serum inflammation and boosting patients' life quality.

Keywords: Laparoscopic surgery and open surgery, early-stage endometrial cancer, inflammatory factors, therapeutic effect, quality of life

Introduction

Endometrial cancer (EC) is the most common malignancy of the female reproductive system and ranks the sixth most frequently diagnosed cancer among women [1]. In the United States alone, nearly 70,000 new EC cases and 15,000 deaths were reported in 2024 [2]. Although EC affects predominantly postmenopausal women, 15-25% of cases occur in premenopausal individuals [3]. Clinical manifestations in premenopausal EC patients include abnormal uterine bleeding, intermenstrual bleeding, and mild pelvic pain [4].

EC prognosis is closely associated with the stage at diagnosis. The 5-year survival rate reaches approximately 80% in patients with

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early-stage EC (EEC; stages I-II), but decreases to about 58% in advanced-stage patients (stages III-IV), especially with the presence of pelvic lymph node metastasis [5]. Standard treatment for EEC typically involves total hysterectomy with bilateral salpingo-oophorectomy to achieve curative resection. However, postoperative inflammatory responses may compromise smooth recovery and quality of life (QoL) [6, 7].

Conventional open surgery, while effective in achieving a radical cure, is associated with greater surgical trauma, which may aggravate systemic inflammatory responses and increase the risk of postoperative complications [8]. Both laparoscopic and open procedures can achieve radical cure, with their primary differences lying in surgical technique and perioperative effects [9]. Laparoscopic technique has emerged as a minimally invasive alternative, offering advantages such as reduced surgical trauma, improved clinical safety, accelerated postoperative recovery, and less physiologic stress [10].

Therefore, laparoscopic surgery may exert a more favorable effect on postoperative inflammatory responses and contribute to improved QoL in patients with EC [11]. This study aims to verify the hypothesis that laparoscopic surgery is superior to open surgery in reducing inflammation and enhancing QoL in EEC patients. Findings in this study are expected to offer more reliable clinical evidence for optimizing postoperative recovery.

Materials and methods

Case selection

Inclusion criteria: a confirmed diagnosis of EC based on clinicopathologic and imaging examinations [12]; postoperative pathologic staging of International Federation of Gynecology and Obstetrics (FIGO) stage I/II disease [13]; an expected survival time exceeding 12 months; complete medical records; and no surgical contraindications.

Exclusion criteria: receipt of preoperative chemoradiotherapy and/or radiotherapy; concomitant malignancies; a history of abdominal/pelvic procedures; severe comorbidities such as uncontrolled hypertension or diabetes; acute or chronic infectious diseases; severe dysfunction of major organs (e.g., liver, kidney); mental illnesses; or inability to communicate effectively.

This study was approved by the Ethical Committee of Youjiang Medical University for Nationalities prior to study initiation. A total of 165 EC patients who underwent surgical treatment at our hospital between January 2023 and June 2025 were retrospectively included following the above case selection criteria. Among them, 80 patients who underwent open surgery were assigned to the control group, and 85 patients who received laparoscopic surgery were included in the research group.

Interventions

Patients in the research group underwent laparoscopic surgery. Following routine preoperative preparation and general anesthesia, pneumoperitoneum was established and a laparoscope was inserted. Auxiliary trocars were placed at McBurney's point in the right lower abdomen, left abdomen, and left lower abdomen. A comprehensive intra-abdominal exploration was performed to assess surgical feasibility. Peritoneal washings were obtained for cytologic examination. The bilateral pelvic peritoneum was incised using an ultrasonic scalpel, and the ureters were dislocated to enable adequate exposure of the operative field. The ovarian infundibulopelvic ligaments were coagulated and transected, followed by systematic pelvic lymphadenectomy, including lymph nodes along the iliac vessels and within the obturator fossa. The round ligaments were divided, and the uterovesical peritoneal reflection was opened to mobilize the bladder inferiorly. The posterior leaf of the broad ligament was then dissected to expose the sacrum ligaments. Subsequently, the uterine vessels were skeletonized, coagulated, and transected. The uterosacral ligaments were then clamped, coagulated, and divided bilaterally. Hemostasis was achieved through bipolar electrocoagulation, after which a circumferential incision was made along the vaginal fornix using a uterine manipulator, and the uterus with bilateral adnexa were removed transvaginally.

Patients in the control group underwent open surgery under general anesthesia. A lower abdominal midline incision of approximately 12 cm was made, and the abdominal wall was opened layer by layer. Following high ligation of the infundibulopelvic ligaments, hysterectomy

and pelvic lymphadenectomy were performed using techniques comparable to those in the research group. After specimen removal, hemostasis was achieved by electrocoagulation. The pelvic and abdominal cavities were irrigated with normal saline before closure of the incision.

Postoperatively, all patients received a standardized multimodal analgesia scheme. Patient-controlled intravenous analgesia (PCIA) was administered using sufentanil (1.5 μg/kg) combined with tropisetron (10 mg), diluted to 100 mL with normal saline. The infusion was delivered at a background rate of 2 mL/h, with a patient-controlled bolus dose of 1 mL and a lockout interval of 15 minutes. For patients with a Visual Analogue Scale (VAS) of ≥4, additional oral celecoxib (200 mg) was provided. The analgesic protocol was uniformly implemented by anesthesiology nursing staff and maintained for 72 hours postoperatively.

Data collection and outcome measures

Treatment efficacy: Therapeutic efficacy was evaluated according to predefined criteria [14]. *Marked response* was defined as significant improvement or complete resolution of clinical symptoms (e.g., vaginal discharge, vaginal bleeding, and lower abdominal pain); *response* was defined as partial improvement in the above-mentioned symptoms; *non-response* was defined as no improvement or even worsening of symptoms. The overall response rate (ORR) was calculated as the percentage of patients achieving marked response and response among all cases.

Safety: Postoperative complications, including incision infection, intestinal injury, ureteral injury, lower-limb deep venous thrombosis (DVT), and urinary retention, were recorded for both groups, and the incidence rate was calculated.

Surgical indicators: Intraoperative blood loss, operative time, and lymph node yield were recorded.

Postoperative recovery: Recovery outcomes were assessed by recording the time to intestinal function recovery, duration of bed rest, and length of hospital stay.

Bladder function: Bladder function was evaluated based on the time to first spontaneous urination, post-void residual (PVR) urine volume, and time to micturition recovery. The time to first spontaneous urination was defined as the interval from postoperative urinary catheter removal to the first voluntary voiding. PVR urine volume was measured immediately after voiding using an ultrasound bladder scanner, with <50 mL considered normal. Recovery of normal micturition was defined achieving PVR <50 mL on two consecutive measurements without the need for re-catheterization.

Urodynamic function: Urodynamic data were assessed, including free flow rate (maximum urinary flow rate, Qmax), filling-phase bladder pressure, and voiding synchronous pressure-flow study. For Qmax measurement, patients were instructed to void naturally at a strong desire to urinate, and the Q_{max} was recorded using an uroflowmeter. For filling-phase bladder pressure, normal saline or carbon dioxide was infused into the bladder at a rate of 50 mL/min through a 6-F double-lumen transurethral catheter, and detrusor pressure was continuously monitored. Voiding synchronous pressure-flow studies were conducted in strict accordance with International Continence Society (ICS) standards, and intravesical and abdominal pressure were recorded by rectal or vaginal catheterization to calculate detrusor pressure. The detrusor pressure at maximum flow (Pdet@Qmax) was determined. Bladder outlet obstruction was defined as Pdet@Qmax >40 cmH_2O combined with Qmax <15 mL/s.

Inflammatory markers: fasting venous blood samples (5 mL) were collected before and 6 months after the operation. Serum was separated by centrifugation and analyzed for interleukin (IL)-6, tumor necrosis factor (TNF)-α, and high-sensitivity C-reactive protein (hs-CRP) levels using enzyme-linked immunosorbent assay (ELISA).

Quality of life (QoL): QoL was assessed before and 6 months following the procedure using the 36-Item Short-Form Health Survey (SF-36) [15], including the domains of role-emotional, social functioning, physical functioning, and general health (0-100 points per domain). The score correlates positively with the QoL.

Statistical methods

All statistical analyses were conducted using SPSS version 22.0. Continuous variables con-

Table 1. Comparison of baseline characteristics between the two groups

	Control group (n=80)	Research group (n=85)	χ^2/t/Z	P
Age (years)	53.45±7.33	54.99±6.56	1.424	0.156
Body mass index (kg/m^2)	24.02±2.18	23.47±2.00	1.690	0.093
FIGO staging (I/II)	52 (65.00)/28 (35.00)	52 (61.18)/33 (38.82)	0.259	0.611
Differentiation degree (low-to-moderate/high)	44 (55.00)/36 (45.00)	45 (52.94)/40 (47.06)	0.070	0.791
Pathological type (endometrioid adenocarcinoma/non-endometrioid adenocarcinoma)	73 (91.25)/7 (8.75)	75 (88.24)/10 (11.76)	0.405	0.524
Menopause (no/yes)	70 (87.50)/10 (12.50)	77 (90.59)/8 (9.41)	0.404	0.525
Tumor diameter (cm)	4.92 (3.07, 6.05)	4.66 (3.37, 5.75)	-0.409	0.682

Note: FIGO, International Federation of Gynecology and Obstetrics.

Table 2. Comparison of treatment response between the two groups

Response	Control group (n=80)	Research group (n=85)	χ^2	P
Marked response	22 (27.50)	30 (35.29)		
Response	38 (47.50)	47 (55.29)		
Non-response	20 (25.00)	8 (9.41)		
Overall response rate	60 (75.00)	77 (90.59)	7.107	0.008

Table 3. Comparison of safety profile between the two groups

Adverse event	Control group (n=80)	Research group (n=85)	χ^2	P
Incision infection	4 (5.00)	0 (0.00)		
Intestinal injury	3 (3.75)	0 (0.00)		
Ureteral injury	4 (5.00)	2 (2.35)		
Lower limb deep venous thrombosis	3 (3.75)	2 (2.35)		
urinary retention	2 (2.50)	2 (2.35)		
Total	16 (20.00)	6 (7.06)	5.973	0.015

forming to a normal distribution were expressed as mean ± standard deviation (SD), and comparisons were performed using independent-samples t-test (between groups) and paired t-test (pre- vs. post-treatment within groups). Non-normally distributed data were presented as median (inter-quartile range) [M (Q1, Q3)] and analyzed using the Mann-Whitney *U* test. Categorical variables were expressed as n [%] and compared using the χ^2 test. A two-sided P<0.05 was considered significant.

Results

Comparison of baseline data between the two groups

As shown in **Table 1**, there were no significant differences between the two groups in age, body mass index (BMI), FIGO stage, differentiation degree, pathological type, menopause status, or tumor diameter (all P>0.05), indicating good baseline comparability.

Comparison of treatment efficacy between the two groups

As shown in **Table 2**, the number of responders was 60 in the control group, significantly lower than 77 in the research group (P=0.008), indicating higher overall response rate in the laparoscopic group.

Comparison of safety profile between the two groups

As shown in **Table 3**, the incidences of incision infection, intestinal injury, ureteral injury, lower-limb DVT, and urinary retention in the control group were 4, 3, 4, 3, and 2 cases, respectively, compared to 0, 0, 2, 2, and 2 cases in the research group. The overall incidence of post-

Table 4. Comparison of surgical findings between the two groups

Findings	Control group (n=80)	Research group (n=85)	Z/t	P
Intraoperative blood loss (mL)	295.00 (250.30, 364.80)	189.00 (132.00, 250.00)	-6.821	<0.001
Operation time (min)	171.50 (138.50, 217.00)	148.00 (116.50, 171.00)	-3.606	<0.001
Lymph node yield	18.01±5.11	21.78±4.61	4.981	<0.001

Table 5. Comparison of postoperative recovery between the two groups

Indicator	Control group (n=80)	Research group (n=85)	t/Z	P
Time to intestinal function recovery (h)	44.35±8.05	32.01±7.24	10.365	<0.001
Duration of bed rest (d)	3.00 (2.00, 4.00)	2.00 (1.00, 3.00)	-5.606	<0.001
Hospital stay (d)	10.00 (8.00, 12.00)	6.00 (4.00, 7.00)	-7.688	<0.001

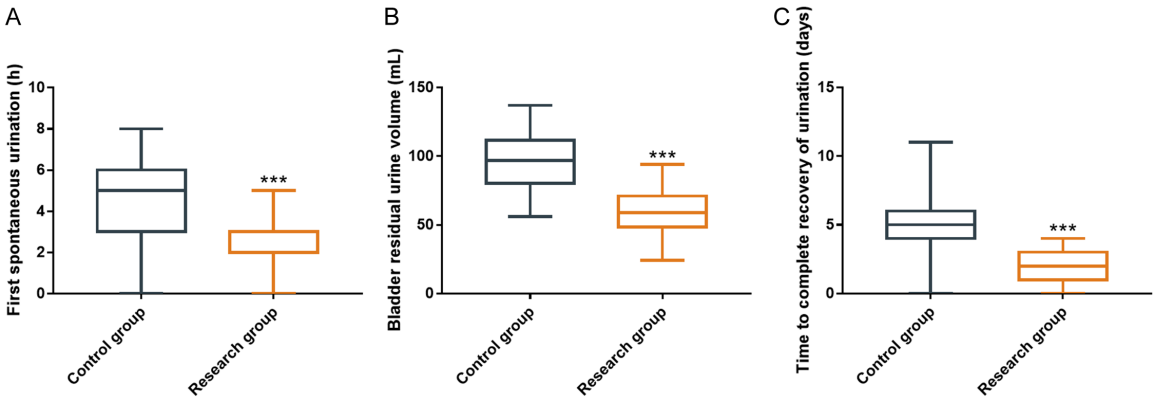

Figure 1. Comparison of bladder function between the two groups. A. Time to first spontaneous urination. B Post-void residual urine volume. C. Time to complete micturition recovery. Note: ***P<0.001 vs. controls.

operative complications was lower in the research group compared to the control group (P=0.015).

Comparison of surgical outcomes between the two groups

As shown in **Table 4**, the research group demonstrated significantly reduced intraoperative blood loss and shorter operation time, along with a higher lymph node yield compared to the control group (all P<0.001).

Comparison of postoperative recovery between the two groups

As shown in **Table 5**, the time to intestinal function recovery, duration of bed rest, and length of hospital stay were all significantly shorter in the research group compared to the control group (all P<0.001).

Comparison of bladder function between the two groups

As shown in **Figure 1**, patients in the research group showed a shorter time to first spontaneous urination, lower post-void residual urine volume, and faster recovery of normal micturition compared to the control group (all P<0.001).

Comparison of urination function between the two groups

As illustrated in **Figure 2**, there were no significant differences between the two groups in baseline urodynamic indicators, including Qmax, filling-phase bladder pressure, and pressure-flow study (all P>0.05). Postoperatively, although all indicators decreased markedly in both groups (control group: all P<0.001; research group: all P<0.001), their levels were

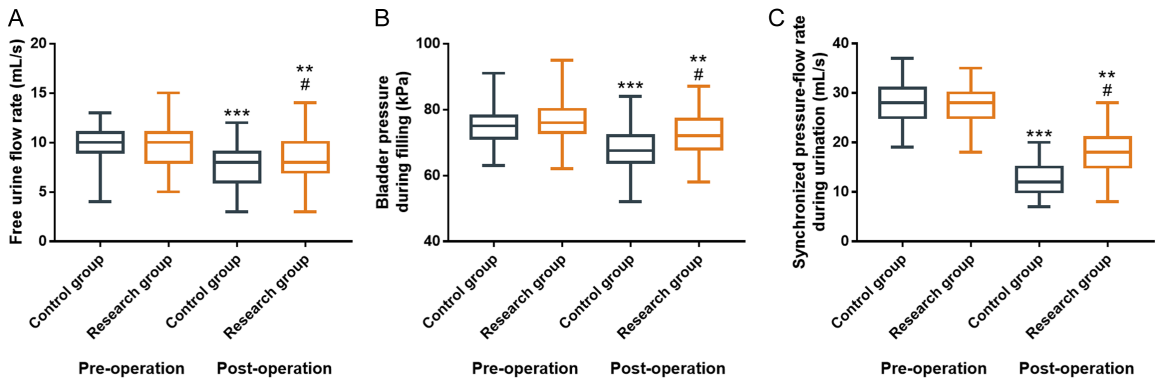

Figure 2. Comparison of Urodynamic outcomes between the two groups before and after treatment. A. Free flow rate. B. Filling-phase bladder pressure. C. Synchronized pressure-flow rate. Note: **P<0.01, ***P<0.001 vs. pre-operative value; #P<0.05 vs. control group.

Table 6. Comparison of inflammatory markers between the two groups

Biomarker	Control group (n=80)	Research group (n=85)	t	P
IL-6 (pg/L)				
Pre-operation	4.50±1.97	4.81±2.09	0.979	0.329
Post-operation	3.33±1.27***	2.23±0.90***	6.449	<0.001
TNF-α (μg/L)				
Pre-operation	4.10±1.75	4.21±1.83	0.394	0.694
Post-operation	2.39±0.88***	1.51±0.72***	7.128	<0.001
hs-CRP (mg/L)				
Pre-operation	25.57±4.59	26.47±5.04	1.197	0.233
Post-operation	15.46±4.97***	12.11±3.49***	5.034	<0.001

Note: ***P<0.001 vs. preoperative value. IL-6, Interleukin-6; TNF-α, Tumor Necrosis Factor-alpha; hs-CRP, High-sensitivity C-Reactive Protein.

higher in the research group compared to the control group (P=0.030, P<0.001, P<0.001, respectively).

Comparison of serum inflammatory markers between the two groups

As shown in **Table 6**, preoperative levels of IL-6, TNF-α, and hs-CRP showed no significant differences between the two groups (all P>0.05). Postoperatively, these inflammatory markers decreased significantly in both groups, with significantly lower levels observed in the research group (all P<0.001).

Comparison of QoL scores between the two groups

As shown in **Table 7**, baseline SF-36 scores were comparable between the two groups across four domains (role-emotional, social functioning, physical functioning, and general health) (all P>0.05). Post-operatively, SF-36 scores improved significantly in both groups, with greater improvements observed in the research group (all P<0.001).

Discussion

Our study demonstrated that the overall response rate was significantly higher in EC patients undergoing laparoscopic surgery compared to those receiving open surgery, indicating a potential advantage of the minimally invasive approach in improving clinical outcomes. Additionally, laparoscopic surgery was associated with an evidently lower incidence of postoperative complications, including incision infection, intestinal injury, ureteral injury, lower limb DVT, and urinary retention, suggesting a superior safety profile compared to open surgery. Consistent with our observations, Bogani et al. [16] reported that laparoscopic surgery is a safe and effective procedure for EC.

Table 7. Comparison of quality of life between the two groups

Indicator	Control group (n=80)	Research group (n=85)	t	P
Role-emotional (points)				
Pre-operation	60.52±5.19	60.84±6.28	0.356	0.723
Post-operation	67.43±6.24***	75.00±5.85***	8.043	<0.001
Social functioning (points)				
Pre-operation	63.17±6.84	62.68±5.69	0.501	0.617
Post-operation	66.78±7.04**	74.68±7.08***	7.183	<0.001
Physical functioning (points)				
Pre-operation	59.02±5.66	60.34±6.61	1.374	0.171
Post-operation	65.44±6.74***	74.60±6.08***	9.176	<0.001
General Health (points)				
Pre-operation	54.36±4.75	55.68±5.99	1.562	0.120
Post-operation	65.10±6.31***	79.78±6.53***	14.670	<0.001

Note: **P<0.01, ***P<0.001 vs. pre-operative.

Furthermore, laparoscopic surgery resulted in reduced intraoperative blood loss, shorter operation time, and a higher lymph node yield, indicating improved surgical efficiency compared to open surgery. This may be associated with the minimally invasive nature of laparoscopy. Specifically, the use of high-resolution visualization systems and refined surgical instruments allows for enhanced exposure of anatomic structures and precise dissection, thereby improving operative efficiency. Moreover, the reduced surgical trauma associated with laparoscopy minimizes damage to surrounding tissues, thus lowering the risk of postoperative complications and facilitating postoperative recovery. Similarly, Gan et al. [17] demonstrated that laparoscopic surgery significantly reduced intraoperative blood loss and postoperative complications, consistent with the results of the current study.

Regarding postoperative recovery, patients in the laparoscopic group exhibited faster restoration of intestinal function, shorter duration of bed rest, and reduced length of hospital stay compared to those receiving open surgery, suggesting that laparoscopic surgery is more conducive to enhanced postoperative recovery. This may be explained by the smaller incision and reduced tissue trauma associated with laparoscopic procedures, in contrast to the larger abdominal incision required for open surgery, which may delay postoperative rehabilitation. Consistently, Ma et al. [18] reported that laparoscopic surgery significantly reduced blood loss and shortened hospitalization time compared with open surgery. Similarly, Mourits et al. [19] reported shorter operation time and faster recovery with laparoscopic surgery in patients with stage I endometrioid adenocarcinoma or complex atypical hyperplasia, further supporting our findings.

In this study, both bladder and urodynamic function were better preserved in EC patients undergoing laparoscopic surgery compared with those receiving open surgery. Consistent with our results, Higgs et al. [20] reported that laparoscopic surgery in patients with EEC did not notably affect their pelvic floor function, including urinary, intestinal, and prolapse-related symptoms, compared to their preoperative status.

Inflammation plays a critical role in tumor progression and postoperative recovery. IL-6, TNF-α, and hs-CRP are well-established inflammatory biomarkers. IL-6 has been reported to correlate with tumor burden and disease stage in EC, and IL-6, together with TNF-α, are involved in tumor proliferation, invasion, and metastasis. In addition, hs-CRP may contribute to EC progression through activation of the fragment γ receptors (FcgRs)/nuclear factor κB (NF-κB)/nucleotide-binding oligomerization domain (NOD)-like receptor pyrin domain-containing protein 3 (NLRP3) pathway [21-23]. Therefore, this study selected IL-6, TNF-α, and hs-CRP as representative inflammatory indicators. Our results demonstrated that laparoscopic surgery was associated with significantly lower postoperative levels of IL-6, TNF-α, and hs-CRP,

indicating a more pronounced attenuation of the systemic inflammatory response. This effect may be attributed to the reduced surgical trauma associated with laparoscopic procedures, which leads to reduced stress response and decreased release of pro-inflammatory cytokines. Moreover, the minimally invasive approach may limit tissue injury, ischemia-reperfusion damage, and subsequent inflammatory cascade activation, thereby contributing to improved postoperative recovery [24-26].

In terms of QoL, patients receiving laparoscopic surgery exhibited significantly greater improvements across multiple SF-36 domains, including role-emotional, social functioning, physical function, and general health. The advantages of laparoscopic surgery such as accelerated postoperative recovery, lower complication rates, better preservation of bladder and urinary functions collectively contribute to an enhanced perception of health status. These benefits facilitate earlier mobilization, shorter hospitalization, and earlier return to family and social activities. Open surgery, on the contrary, is associated with greater surgical trauma and delayed recovery, thereby limiting the extent of QoL improvement.

Although this study demonstrated the overall superiority of laparoscopic surgery over open surgery, the choice of surgical approach should be individualized based on comprehensive risk stratification, including FIGO stage and tumor grade. Referring to clinical practice and related literature [27, 28], laparoscopic surgery is generally recommended for low-risk patients (e.g., FIGO stage IA, grade G1/G2, myometrial infiltration <50%), since it provides comparable oncological outcomes to open surgery and significant benefits in postoperative recovery and QoL. For high-risk patients (e.g., FIGO stage IB with grade 3, stage II disease, or high-risk histologic subtypes such as clear cell/serous endometrial cancer), open surgery may still be considered, particularly when extensive staging or lymphadenectomy is required. In such cases, the surgical approach should be determined based on preoperative pathologic findings and surgeon expertise. Therefore, individualized surgical planning integrating preoperative pathological and imaging findings is essential to optimize clinical outcomes.

Several limitations of this study should be acknowledged. First, given the monocentric design with only 165 cases enrolled, multicenter research with an expanded sample size is warranted to enhance the generalizability of the findings. Second, subgroup analyses based on risk stratification were not performed, which may have obscured potential differences in treatment effects among distinct patient populations. Future studies should incorporate stratified analyses to identify the specific EC populations who may derive the greatest benefits from laparoscopic surgery. Third, although this study explored inflammatory markers and proposed potential involvement of the NF-κB pathway, no direct molecular evidence (e.g., protein expression or phosphorylation levels) was provided. Further mechanistic studies are needed to elucidate the underlying biological pathways.

Conclusion

Laparoscopic surgery demonstrates superiority over open surgery for EC treatment, including improved perioperative outcomes, reduced inflammatory response, enhanced recovery, and better quality of life, supporting its broader clinical promotion.

Disclosure of conflict of interest

None.

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References

[1] Matsuura M, Nagao S, Kurokawa S, Tamate M, Akimoto T and Saito T. Surgical outcomes of da Vinci Xi and da VINCI SP for early-stage endometrial cancer in patients undergoing hysterectomy. J Clin Med 2024; 13: 2864.

[2] Siegel RL, Giaquinto AN and Jemal A. Cancer statistics, 2024. CA Cancer J Clin 2024; 74: 12-49.

[3] Aimagambetova G, Terzic S, Lagana AS, Bapayeva G, la Fleur P and Terzic M. Contemporary fertility-sparing management options of early stage endometrioid endometrial cancer in young nulliparous patients. J Clin Med 2021; 11: 196.

[4] Gullo G, Cucinella G, Chiantera V, Dellino M, Cascardi E, Török P, Herman T, Garzon S, Uccella S and Laganà AS. Fertility-sparing strategies for early-stage endometrial cancer: stepping towards precision medicine based on the molecular fingerprint. Int J Mol Sci 2023; 24: 811.

[5] Fumagalli D, De Vitis LA, Caruso G, Occhiali T, Palmieri E, Guillot BE, Pappalettera G, Langstraat CL, Glaser GE, Reynolds EA, Fruscio R, Landoni F, Mariani A and Grassi T. Low-volume metastases in apparent early-stage endometrial cancer: prevalence, clinical significance, and future perspectives. Cancers (Basel) 2024; 16: 1338.

[6] Hu X, Zhou L and Lin R. Systemic immune-inflammation index and lymphocyte-to-monocyte ratio predict recurrence after radical surgery for stage I/II endometrial cancer. Am J Cancer Res 2025; 15: 3471-3485.

[7] Meng S, Cao Y, Shen Q, Dong L and Wang N. Comparison of tissue damage and inflammation for robotic laparoscopy and conventional laparoscopy in early endometrial cancer. Front Med (Lausanne) 2024; 11: 1492469.

[8] Natarajan P, Delanerolle G, Dobson L, Xu C, Zeng Y, Yu X, Marston K, Phan T, Choi F, Barzilova V, Powell SG, Wyatt J, Taylor S, Shi JQ and Hapangama DK. Surgical treatment for endometrial cancer, hysterectomy performed via minimally invasive routes compared with open surgery: a systematic review and network meta-analysis. Cancers (Basel) 2024; 16: 1860.

[9] Ikebuchi A, Komatsu H, Yamamoto K, Okawa M, Hikino K, Iida Y, Hosokawa M, Sawada M, Kudoh A, Sato S, Harada T and Taniguchi F. Outcome of robot-assisted surgery for stage IA endometrial cancer compared to open and laparoscopic surgeries: a retrospective study at a single institution. J Robot Surg 2024; 18: 133.

[10] Sasano T, Mabuchi S, Komura N, Maeda M, Kamiura S, Morishima T and Miyashiro I. Evaluation of survival outcomes between minimally invasive and open surgery in the treatment of early-stage endometrial cancer: a population-based study in Osaka Japan. Jpn J Clin Oncol 2023; 53: 791-797.

[11] Mandato VD, Paterlini M, Torricelli F, Rabitti E, Mastrofilippo V and Aguzzoli L. Perceived social support and quality of life in endometrial cancer patients: a longitudinal study. Front Oncol 2024; 14: 1447644.

[12] Ramirez SP, Fidalgo AP, Ginesta MPB, De Juan Ferré A, Madrid LF, Martinez AG, Montosa FG, Madariaga A, Gomez TM and Gil-Martin M. SEOM-GEICO clinical guidelines on endometrial cancer (2025). Clin Transl Oncol 2025; 27: 4368-4380.

[13] Libert D, Hammer PM, Hui C, Kidd EA, Folkins AK, Longacre T, Yang EJ, Charu V and Howitt BE. Prognostic performance of FIGO 2023 endometrial carcinoma staging: a comparison to FIGO 2009 staging in the setting of known and unknown molecular classification. Histopathology 2024; 85: 804-819.

[14] Post CCB, Westermann AM, Boere IA, Witteveen PO, Ottevanger PB, Sonke GS, Lalisang RI, Putter H, Meershoek-Klein Kranenbarg E, Braak JPBM, Creutzberg CL, Bosse T and Kroep JR. Efficacy and safety of durvalumab with olaparib in metastatic or recurrent endometrial cancer (phase II DOMEC trial). Gynecol Oncol 2022; 165: 223-229.

[15] Kim S, Noh JJ, Kim Y, Cho J, Kang D and Lee YY. Psychometric validation of the functional assessment of cancer therapy-endometrial among endometrial cancer patients. Cancer Med 2024; 13: e7096.

[16] Bogani G, Lalli L, Casarin J, Ghezzi F, Chiappa V, Fanfani F, Scambia G and Raspagliesi F. Ninety-day surgery-related outcomes of laparoscopic hysterectomy, bilateral salpingo-oophorectomy and sentinel node mapping in apparent early-stage endometrial cancer: a secondary analysis of a prospective single-arm study. Eur J Obstet Gynecol Reprod Biol 2025; 314: 114679.

[17] Gan Y, Xu W, Liang S, Zhou C, Li L, Teng Y, Zhu X and Ai Z. Safety of minimally invasive surgery in early-stage endometrial cancer: a systematic Retrospective analysis based on 2023 FIGO staging system☆. Eur J Surg Oncol 2025; 51: 109997.

[18] Ma J, Zhou C, Chen J and Chen X. Prognosis and efficacy of laparoscopic surgery on patients with endometrial carcinoma: systematic evaluation and meta-analysis. Comput Math Methods Med 2022; 2022: 9384134.

[19] Mourits MJ, Bijen CB, Arts HJ, ter Brugge HG, van der Sijde R, Paulsen L, Wijma J, Bongers MY, Post WJ, van der Zee AG and de Bock GH. Safety of laparoscopy versus laparotomy in early-stage endometrial cancer: a randomised trial. Lancet Oncol 2010; 11: 763-771.

[20] Higgs P, Janda M, Asher R, Gebski V, Forder P and Obermair A. Pelvic floor functional outcomes after total abdominal vs total laparoscopic hysterectomy for endometrial cancer. Am J Obstet Gynecol 2018; 218: 419.e411-419.e414.

[21] Madeddu C, Sanna E, Gramignano G, Tanca L, Cherchi MC, Mola B, Petrillo M and Maccio A. Correlation of leptin, proinflammatory cytokines and oxidative stress with tumor size and disease stage of endometrioid (Type I) endometrial cancer and review of the underlying mechanisms. Cancers (Basel) 2022; 14: 268.

[22] Ray I, Meira LB, Michael A and Ellis PE. Adipocytokines and disease progression in endometrial cancer: a systematic review. Cancer Metastasis Rev 2022; 41: 211-242.
[23] Socha MW, Malinowski B, Puk O, Wartega M, Bernard P, Nowaczyk M, Wolski B and Wicinski M. C-reactive protein as a diagnostic and prognostic factor of endometrial cancer. Crit Rev Oncol Hematol 2021; 164: 103419.
[24] Bohne A, Grundler E, Knüttel H, Fürst A and Völkel V. Influence of laparoscopic surgery on cellular immunity in colorectal cancer: a systematic review and meta-analysis. Cancers (Basel) 2023; 15: 3381.
[25] Sohrab SS, Raj R, Nagar A, Hawthorne S, Paiva-Santos AC, Kamal MA, El-Daly MM, Azhar EI and Sharma A. Chronic inflammation's transformation to cancer: a nanotherapeutic paradigm. Molecules 2023; 28: 4413.
[26] Lu SL, Zhang QY, Zhao YQ, Wu HL, Lin J, Zhu P, Qin ZJ, Wang XB and Chen J. C-reactive protein to albumin ratio combined with the systemic inflammatory response Index predicts the prognosis of patients undergoing radical hepatectomy. BMC Cancer 2025; 25: 784.
[27] Restaino S, Paglietti C, Arcieri M, Biasioli A, Della Martina M, Mariuzzi L, Andreetta C, Titone F, Bogani G, Raimondo D, Perelli F, Buda A, Petrillo M, Greco P, Ercoli A, Fanfani F, Scambia G, Driul L and Vizzielli G; The Udine Hospital Gynecological-Oncological Tumor Board G. Management of patients diagnosed with endometrial cancer: comparison of guidelines. Cancers (Basel) 2023; 15: 1091.
[28] Auletta V, Hassan ME, Kather A, Gassler N, Bokhua D and Runnebaum IB. Minimally invasive surgery in endometrial cancer: superior for low-risk and comparable for high-risk cases in a 20-year cohort study. Geburtshilfe Frauenheilkd 2025; 85: 724-735.