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Original Article

Laparoscopic radical hysterectomy and pelvic lymph node dissection for early cervical cancer effectively improves surgical efficacy

Mingyan Luo*, Yuyang Liu*, Yumei Lv

*Western Theater Command General Hospital, Chengdu 610083, Sichuan, China. *Equal contributors and co-first authors.*

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Abstract: Objective: To evaluate the efficacy and safety of laparoscopic radical hysterectomy (LRH) combined with pelvic lymph node dissection (PLND) in patients with early-stage cervical cancer. Methods: This retrospective study analyzed 58 cases of early cervical cancer who underwent surgical treatment at Western Theater Command General Hospital between January 2019 and September 2020. Patients were divided into two groups based on surgical approach: the observation group (n=26) received LRH and PLND without uterine manipulator, while the control group (n=32) underwent LRH with uterine manipulator and PLND. Clinical data including operative time, intraoperative blood loss, time to first flatus, postoperative hospital stay, number of lymph nodes dissected, and postoperative pain (VAS score at 7 days) were compared between groups. Serum tumor markers (CA125, CA199, CEA, and SCC) were measured and analyzed. Postoperative complications and quality of life were assessed during a 6-month follow-up period. Patients were further categorized into good prognosis (n=40, no recurrence) and poor prognosis (n=18, recurrence) groups based on 1-year follow-up outcomes to identify independent prognostic factors. Results: The observation group demonstrated significantly better outcomes compared to the control group, including shorter operative time, reduced intraoperative blood loss, earlier return of bowel function, shorter hospital stay, lower postoperative pain scores, and decreased serum tumor marker levels (all $P<0.05$). The observation group also had a higher number of lymph nodes dissected ($P<0.05$). Furthermore, this group showed a significantly lower incidence of postoperative complications and better quality of life at 6 months postoperatively ($P<0.05$). Multivariate analysis identified the number of lymph nodes dissected and surgical approach as independent prognostic factors. Conclusion: LRH without uterine manipulator combined with PLND demonstrates superior surgical outcomes, reduced complication rates, and improved recovery for patients with early-stage cervical cancer, representing a valuable advancement in clinical practice.

Keywords: Laparoscopy, abdominal uterus, wide hysterectomy, pelvic lymph node dissection, early cervical cancer, efficacy

Introduction

Cervical cancer remains one of the most prevalent gynecologic malignancies, predominantly affecting women between 30 and 65 years of age. It ranks as the second leading cause of cancer-related mortality among all female genital tract malignancies, with a worrying trend toward younger age at diagnosis [1, 2]. Cervical cancer significantly affects patients' physical and psychological health and can be life-threatening if not properly managed. Early diagnosis and prompt treatment are essential for improving patient prognosis [3]. With increased awareness of women's health, advancements in diagnostic methods, and the widespread implementation of cervical cytology screening programs, more cases are being detected and managed at earlier stages, contributing to a reduction in mortality rates [4].

The current clinical management of cervical cancer primarily include radiotherapy, chemotherapy, and surgery, with surgery remaining the mainstay treatment for early-stage cervical cancer [5]. While abdominal radical hysterecto-

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my combined with pelvic lymphadenectomy has traditionally been the standard approach for early cervical cancer, this technique is associated with significant limitations, including extensive surgical trauma, limited operative visualization, and prolonged postoperative recovery. These drawbacks not only contribute to patient discomfort but also increase the risk of complications, prolonged hospitalization, and reduced patient acceptance [6, 7].

Since its introduction in the 1990s, laparoscopic surgery has gained widespread adoption in gynecological oncology due to its advantages of minimal invasiveness, enhanced visualization, and flexible operative maneuverability [8]. The magnified view provided by laparoscopy enables accurate identification of pelvic structures, small vessels, and lymph nodes in anatomically complex regions during pelvic lymphadenectomy [9]. However, conventional laparoscopic hysterectomy procedures often rely on uterine manipulators for uterine elevation, which, despite their utility, carry risks such as vaginal wall injury and uterine perforation, limiting their clinical application [10]. Laparoscopic total hysterectomy without uterine manipulators has emerged as a safer and more efficient alternative. This approach eliminates the risks associated with uterine manipulators, reduces the need for specialized equipment or additional personnel, and demonstrates clinical benefits such as decreased postoperative vaginal pain and accelerated recovery, ultimately improving patient outcomes [11].

This study selected 58 patients with early-stage cervical cancer treated at our institution, aiming to evaluate the efficacy and safety of laparoscopic radical hysterectomy without uterine manipulator combined with pelvic lymph node dissection in the management of early cervical cancer.

Materials and methods

Case selection

This retrospective study included 58 patients with clinically diagnosed early-stage cervical cancer who underwent surgical treatment at Western Theater Command General Hospital between January 2019 and September 2020. Based on surgical treatment plans, 32 patients who underwent total laparoscopic radical hysterectomy (LRH) with uterine manipulator combined with pelvic lymph node dissection (PLND) were assigned into the control group; while the other 26 cases who underwent LRH without uterine manipulator, in combination with PLND, were assigned as the observation group.

Inclusion criteria: (1) Pathologically confirmed early-stage cervical cancer; (2) Age ≥35 years; (3) Patients who could tolerate surgery; (4) Preoperative evaluation confirming lesions confined to the uterine body, with tumor diameter <4 cm, no cervical involvement, and no intra-abdominal metastasis; (5) Availability of complete clinical data required for the study. Exclusion criteria: (1) Concurrent endometriosis; (2) Severe organ dysfunction; (3) Significant underlying systemic diseases; (4) Active inflammatory or infectious conditions; (5) History of multiple abdominal surgeries; (6) Suspected multiple tumor metastases; (7) Refusal to undergo surgical treatment; (8) Immune or coagulation disorders. Furthermore, this investigation was approved by the Ethics Committee of Western Theater Command General Hospital and conducted in accordance with the principles of the Declaration of Helsinki.

Interventions

The control group underwent LRH with a uterine manipulator and pelvic lymph node dissection. One day prior to surgery, patients received vaginal douching, skin preparation, preoperative fasting, and intestinal cleansing. Individuals were placed in the modified lithotomy position with the buttocks elevated and head lowered under general anesthesia. Following standard abdominal and perineal cleaning, a towel was laid, and a silicone catheter was inserted. The perineum and vagina were disinfected again, and a uterine lifter was placed to stabilize the uterus. A 1-2 cm arc-shaped incision, 1 cm above the umbilicus, was made to establish pneumoperitoneum (intra-abdominal pressure: 11-13 mmHg), through which a trocar and laparoscope were placed. Two additional incisions, 0.5-1.0 cm each, were made in the left and right lower abdomen, allowing the insertion of additional trocars. After opening the pelvic peritoneum, the common iliac, internal iliac, external iliac, and inguinal lymph nodes were removed, and partial resection of the paraaor-

tic lymph nodes was performed. The bilateral pelvic infundibulopelvic ligaments were severed, ligated at a high position, and dissociated if the patient opted for ovarian non-preservation. If ovarian function preservation was required, the bilateral fallopian tubes were removed along with the mesosalpinx, and the ovarian ligaments was severed. The rectocervical space was then opened, and the rectum was pushed down to approximately 4 cm below the external cervical os. Subsequently, the bladder peritoneal reflection was opened, and the bladder was pushed down to a similar level. The ureters were dissected to fully expose their course, facilitating the separation of the vaginal tissue from the bladder space. The uterine artery was severed at the origin of the internal iliac artery. The ureteral channel was then opened to reveal the sacral and bilateral cardinal ligaments, which were cut 2-3 cm from the cervix. Lymph nodes and uterine appendages were removed through the vagina following the routine inspection after slicing the vaginal wall approximately 3 cm below the cervical entrance, or 3 cm from the external margin of the vaginal lesion. Finally, the vaginal stump was sutured using catgut, the vagina was irrigated, and hemostasis was thoroughly performed in the abdominal cavity. Catheters were indwelled, and the incisions were closed.

The observation cohort underwent LRH and PLND without uterine manipulator. Preoperative preparations included vaginal irrigation, skin preparation, fasting, and intestinal cleansing one day prior to surgery. Under general anesthesia, patients were positioned in a modified lithotomy position with hips elevated and head lowered. The abdomen and perineum were routinely disinfected, draped, and a silicone catheter was indwelled. A 1-2 cm arc-shaped incision was made 1 cm above the umbilicus to establish pneumoperitoneum (intra-abdominal air pressure: 11-13 mmHg), followed by insertion of a trocar and laparoscope. Two additional 0.5-1.0 cm incisions were made in both the left and right lower abdomen, each accommodating a trocar. The pelvic peritoneum was opened, and paraaortic lymph nodes were resected. Common iliac, internal iliac, external iliac, and inguinal lymph nodes were systematically removed and placed in a specimen bag. For patients not requiring ovarian preservation, the bilateral pelvic infundibulopelvic ligaments were severed, dissociated, and ligated at a high position. For ovarian preservation, the bilateral fallopian tubes were removed along the mesosalpinx, and the ovarian ligaments were transected. After that, the rectocervical space was opened, and the rectum was mobilized 4 cm below the external cervical os, followed by the opening of the bladder peritoneal reflection, and the bladder was dissected 4 cm below the external cervical os. The ureter was then dissociated to fully expose its course, and the vaginal tissue was separated from the bladder, with uterine artery ligated at its origin from the internal iliac artery. The ureteral tunnel was opened to expose the cardinal and uterosacral ligaments, which were transected 2-3 cm lateral to the cervix. Subsequently, the vagina was circumferentially sutured 1 cm below the external cervical os, and the vagina was transected 2 cm below the suture line. Lymph nodes and uterine specimens were removed vaginally for pathological examination. The vaginal stump was sutured with absorbable catgut. After thorough hemostasis and vaginal irrigation, the abdominal cavity was inspected, and the incisions were closed following indwelling catheter placement.

Data collection and outcome measurement

(1) Surgical duration (minutes) and intraoperative blood loss (mL) were compared between the two groups; (2) The time to first flatus (hours) and postoperative hospital stay (days) were compared between the two groups; (3) Number of lymph nodes dissected bilaterally were determined and comparatively analyzed; (4) Vaginal pain severity was evaluated 7 days postoperatively using the Visual Analogue Scale (VAS) [12], with scores ranging from 0 (no pain) to 10 (most severe pain); (5) Serum-based tumor biomarkers, including carbohydrate antigen 125 (CA125), CA199, carcinoembryonic antigen (CEA), and squamous cell carcinoma-related antigen (SCC) were measured in both groups 1 month after surgery using the enzyme-linked immunosorbent assay. All kits were procured from Abbott Ireland Diagnostics; (6) Incidence of complications, including urinary retention, lymphocyst formation, postoperative infection, and postoperative bleeding, were recorded and compared between the two groups; (7) The Functional Assessment of Cancer Therapy-General (FACT-G) [13], devel-

Table 1. Comparison of baseline data between the two groups

Factor	Observation Cohort n=26	Control Cohort n=32	t/χ^2	P
Age (years)	49.08±11.69	52.72±8.87	1.348	0.183
Pathological type			0.640	0.726
Adenocarcinoma	3 (11.54)	2 (6.25)		
Squamous cell carcinoma	22 (84.62)	28 (87.50)		
Adenosquamous carcinoma	1 (3.85)	2 (6.25)		
Pathologic stage			2.841	0.092
Stage I	14 (53.85)	24 (75.00)		
Stage II	12 (46.15)	8 (25.00)		

Table 2. Comparison of surgical duration and intraoperative blood loss between the two groups

Item	Observation Cohort n=26	Control Cohort n=32	t	P
Surgical duration (min)	182.38±43.01	205.13±30.68	2.347	0.022
Intraoperative blood loss (ml)	56.92±29.36	84.69±37.16	3.103	0.003

Table 3. Comparison of time to first flatus and postoperative hospital stay between the two groups

Item	Observation Cohort n=26	Control Cohort n=32	t	P
Time to first flatus (h)	33.54±7.6	38.75±7.93	2.535	0.014
Postoperative hospital stay (d)	7.5±1.92	9.06±3.43	2.069	0.043

Table 4. Comparison of the number of lymph node dissected (both sides) between the two groups

Item	Observation Cohort n=26	Control Cohort n=32	t	P
Left	15.73±6	11.25±5.25	3.031	0.003
Right	18.27±6.8	11.56±4.74	4.419	<0.001

oped by the European Organization for Research and Treatment of Cancer, was used to evaluate quality of life six months postoperatively. The assessment included physical, cognitive, emotional, role, and social functioning domains.

Statistical methods

SPSS 19.0 was used for data analysis. Categorical data were expressed as numbers and percentage (%) and analyzed using the Chi-square test (χ^2). Continuous data were expressed as mean ± standard deviation and analyzed using independent t-tests or paired t-tests, as appropriate. Logistic regression was used to identify factors affecting patient prognosis. A *p*-value <0.05 was considered significant.

Results

Comparison of general information between the two groups

No significant differences were observed between the two groups in terms of age, body mass index (BMI), reproductive history, pelvic surgery history, pathological type, or pathological stage (all P>0.05) (**Table 1**).

Comparison of surgical duration and intraoperative blood loss between the two groups

The observation cohort exhibited significantly shorter surgical duration (182.38±43.01 min vs. 205.13±30.68 min, P<0.05) and reduced intraoperative blood loss (56.92±29.36 mL vs. 84.69±37.16 mL, P<0.05) compared to the control cohort (**Table 2**).

Comparison of postoperative recovery indicators between the two groups

The observation cohort demonstrated significantly shorter time to first flatus (33.54±7.6 h vs. 38.75±7.93 h, P<0.05) and reduced postoperative hospital stay (7.5±1.92 d vs. 9.06±3.43 d, P<0.05) compared to the control cohort (**Table 3**).

Comparison of the number of lymph node dissected (both sides) between the two groups

The number of lymph nodes dissected in observation cohort was significantly higher than in the control cohort, both on the left side (15.73±6 vs. 11.25±5.25, P<0.05) and the right side (18.27±6.8 vs. 11.56±4.74, P<0.05) (**Table 4**).

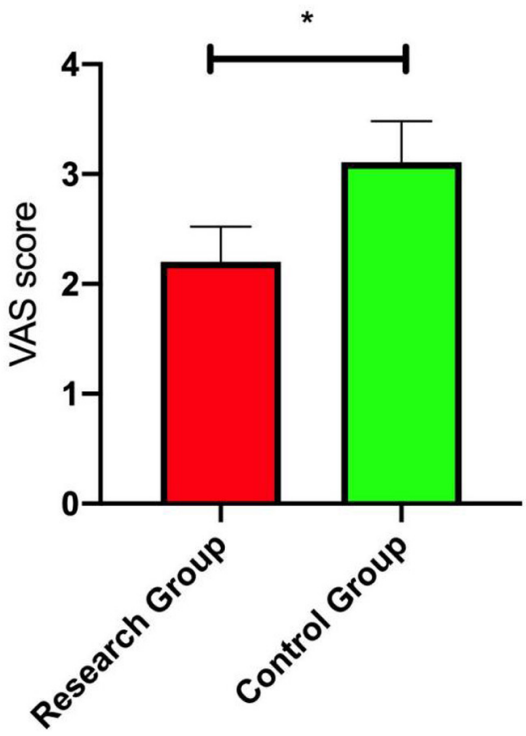

Figure 1. Comparison of postoperative VAS scores between the two groups. Note: VAS: visual analogue scale; *P<0.05.

Comparison of postoperative VAS scores between the two groups

The observation group demonstrated significantly lower VAS score at postoperative 24 hours than the control group (2.2±0.32 vs. 3.11±0.37, P<0.05) (**Figure 1**).

Comparison of serum tumor biomarkers between the two groups

The serum levels of CA125, CA199, CEA and SCC in the observation group were significantly lower than those in the control group (12.48±1.79 U/mL vs. 16.17±5.6 U/mL; 3.19±1.09 U/mL vs. 5±2.86 U/mL; 1.08±0.04 ng/ml vs. 1.78±0.75 ng/ml; 1.12±0.16 μg/L vs. 4.4±7.07 μg/L) (all P<0.05) (**Table 5**).

Comparison of postoperative complications between the two groups

Following treatment, there were 4, 2, 0, and 0 cases of urinary retention, lymphocyst, postoperative infection, and postoperative haemorrhage in the observation cohort, with an overall incidence of 23.08%. While those in control cohort were 6, 6, 1, and 0, respectively, with an overall incidence of 40.63%. The observation group demonstrated a significantly lower incidence rate of postoperative complications (P>0.05) (**Table 6**).

Analysis of factors affecting patient prognosis

The patients were divided into a good prognosis group (n=40; no recurrence) and a poor prognosis group (n=18; recurrence) based on 1-year recurrence status. Univariate analysis revealed that the number of lymph nodes dissected, pathological staging, and treatment method were significantly associated with poor prognosis. Multivariate logistic regression analysis identified the number of lymph nodes dissected and surgical approach as independent prognostic factors (**Tables 7**, **8**).

Comparison of postoperative quality-of-life between the two groups

At 6 months post-surgery, the quality of life scores in the observation cohort were significantly higher than those in the control cohort (P<0.05) (**Table 9**).

Discussion

The incidence of cervical cancer is closely associated with chronic infection with high-risk human papillomavirus (HPV), making it the only gynecologic malignancy with a well-defined etiology [14]. In recent years, surgical treatment has emerged as a cornerstone in the management of cervical cancer. While open abdominal surgery was historically the standard approach, it is associated with a high risk of pelvic autonomic nerve injury, leading to postoperative complications affecting the vagina, bladder, and adjacent organs. These complications significantly hinder postoperative recovery and worsenpatient outcomes [15, 16]. In contrast, laparoscopic hysterectomy offers distinct advantages, including minimized surgical trauma, reduced postoperative complications, shorter hospital stays, and improved prognoses [17]. Nevertheless, emerging evidence suggests that the use of uterine manipulators during laparoscopic procedures may increase the risk of iatrogenic injuries, underscoring the importance for careful consideration in clinical practice [18].

Table 5. Comparison of serum levels of tumor biomarkers between the two groups

	Observation Cohort n=26	Control Cohort n=32	t	P
CA125 (U/mL)	12.48±1.79	16.17±5.6	3.224	0.002
CA199 (U/mL)	3.19±1.09	5±2.86	3.048	0.004
CEA (ng/ml)	1.08±0.04	1.78±0.75	4.746	<0.001
SCC (μg/L)	1.12±0.16	4.4±7.07	2.361	0.022

Notes: CA125: carbohydrate antigen 125; CA199: carbohydrate antigen 199; CEA: carcinoembryonic antigen; SCC: squamous cell carcinoma-related antigen.

Table 6. Comparison of postoperative incidences of adverse reactions between the two groups [n, (%)]

Adverse reaction	Observation Cohort n=26	Control Cohort n=32	χ^2	P
Urinary retention	4 (15.38)	6 (18.75)	-	-
Lymphocyst	2 (7.69)	6 (18.75)	-	-
Postoperative infection	0	1 (3.13)	-	-
Postoperative bleeding	0	0	-	-
Overall complication rate	6 (23.08)	13 (40.63)	2.005	0.157

In this study, the efficacy of total hysterectomy was compared with laparoscopic radical hysterectomy using uterine lifting devices in patients with early-stage cervical cancer. Key surgical data, including operative duration and intraoperative blood loss, were significantly reduced in the group undergoing laparoscopic radical hysterectomy without uterine manipulators compared to the control group. Additionally, the time to first flatus and postoperative hospital stay was notably shorter in the observation group. This could be attributed to the potential risks associated with uterine manipulation during surgery, such as vaginal wall abrasions, uterine perforation, and increased bleeding, which can prolong recovery [19]. The laparoscopic total hysterectomy technique simplifies the surgical process, as the entire procedure is conducted under laparoscopic visualization, which enables precise localization of lesions and meticulous operative techniques, thereby reducing operative time, expediting recovery, and shortening hospitalization duration [20]. We further compared the number of lymph nodes dissected bilaterally and postoperative pain scores (VAS) between the two cohorts. The findings indicated that patients undergoing laparoscopic total hysterectomy without uterine manipulators had a higher number of lymph nodes accurately dissected and lower postoperative VAS scores compared to the control group. These results suggest that laparoscopic total hysterectomy provides superior lymph node dissection precision and minimizes postoperative pain by avoiding secondary trauma to the vaginal wall [21, 22]. The observed benefits may be attributed to the minimally invasive nature of laparoscopy, which reduces surgical stress and intraoperative bleeding. The laparoscopic approach provides a clear surgical field and optimal cervical exposure, facilitating the execution of various surgical steps under combined hysteroscopic and laparoscopic guidance. Furthermore, enhanced visualization allows for precise identification of pelvic blood vessels, lymph nodes, and nerve structures, minimizing unintended damage to surrounding tissues. This approach effectively preserves pelvic autonomic nerve function while achieving complete lesion removal, thereby reducing complications such as bladder dysfunction caused by nerve injury and promoting improved postoperative rehabilitation outcomes [23, 24]. Based on the surgical outcomes analyzed in this study, laparoscopic radical hysterectomy without uterine manipulators can effectively reduce surgical trauma and intraoperative bleeding, representing a safer and less invasive surgical option for patients with early-stage cervical cancer.

Tumor markers serve as essential indicators for assessing the recovery and treatment response in cancer patients. Common tumor markers such as CA125, CA199, CEA, and SCC are widely utilized to evaluate postoperative outcomes in tumor patients [25]. In this study, we compared the postoperative levels of CA125, CA199, CEA, and SCC between the two groups. The results revealed significantly lower levels of CA125, CA199, CEA, and SCC in patients undergoing laparoscopic radical hysterectomy without uterine manipulators, compared to the control group, indicating a superior therapeutic effect with this approach. Additionally, postoperative quality of life and complication rates were evaluated. Patients in the laparoscopic

Table 7. Univariate analysis of factors affecting patient prognosis

Factor	Good prognosis group (n=40)	Poor prognosis group (n=18)	X^2	P
Age	51.13±9.32	51.04±11.58	0.032	0.975
History of pelvic surgery			0.519	0.471
Yes (n=20)	15 (37.50)	5 (27.78)		
No (n=38)	25 (62.50)	13 (72.22)		
Pregnancy frequency			0.432	0.511
≥2 (n=16)	10 (25.00)	6 (33.33)		
<2 (n=42)	30 (75.00)	12 (66.67)		
Pathologic type			0.314	0.855
Adenocarcinoma (n=5)	4(10.00)	1 (5.56)		
Squamous cell carcinoma (n=50)	34 (85.00)	16 (88.89)		
Adenosquamous carcinoma (n=3)	2 (5.00)	1 (5.56)		
Pathological stage			5.130	0.024
Stage I (n=38)	30 (75.00)	8 (44.44)		
Stage II (n=20)	10 (25.00)	10 (55.56)		
Number of lymph node dissections	31.44±11.13	23.38±11	2.561	0.013
Surgical methods				
LRH + PLND (n=26)	24 (60.00)	2 (11.11)	12.00	<0.001
LRH with uterine lifting device + PLND (n=32)	16 (40.00)	16 (88.89)		

Notes: LRH: Laparoscopic radical hysterectomy; PLND: pelvic lymph node dissection.

Table 8. Multivariate analysis of factors affecting patient prognosis

Factor	B	S.E.	Wals	P	Exp (B)	95% C.I.	
						Lower limit	Upper limit
Number of lymph nodes dissected	-0.123	0.047	6.860	0.009	0.884	0.806	0.969
Pathological stage	0.040	0.829	0.002	0.962	1.041	0.205	5.279
Surgical methods	2.490	1.014	6.035	0.014	12.066	1.655	87.994

Table 9. Comparison of postoperative quality of life between the two groups

Quality of life		Observation Cohort n=26	Control Cohort n=32	X^2	P
Physical function	Before treatment	10.28±1.02	10.12±0.91	0.630	0.531
	After treatment	15.41±2.14	13.19±1.23	4.953	<0.001
Cognitive function	Before treatment	10.22±1.16	10.15±1.01	0.246	0.807
	After treatment	16.53±1.88	13.12±1.21	8.357	<0.001
Emotional function	Before treatment	10.88±0.98	10.69±0.84	0.795	0.430
	After treatment	17.34±2.52	13.58±1.06	7.659	<0.001
Role function	Before treatment	10.19±1.03	10.12±1.37	0.216	0.830
	After treatment	16.66±1.72	13.92±1.09	7.378	<0.001
Social function	Before treatment	10.44±1.08	10.31±1.12	0.447	0.657
Before treatment	After treatment	16.31±1.67	14.31±1.05	5.561	<0.001

hysterectomy group experienced significantly improved quality of life and lower complication rates compared to those in the control group. Previous studies have indicated that laparoscopic procedures without uterine manipulators can significantly reduce intraoperative blood loss, minimize trauma, and improve recovery outcomes. This approach also lowers

the risk of vaginal wall abrasions, uterine perforation, and related complications, while offering benefits such as reduced postoperative vaginal pain and faster recovery [26, 27]. These findings underscore the enhanced surgical efficacy and improved clinical outcomes of laparoscopic radical hysterectomy without uterine lifting devices, which supports its potential benefits in postoperative recovery and complication reduction.

Conclusion

Laparoscopic radical hysterectomy without uterine manipulator, combined with pelvic lymph node dissection, significantly improves surgery efficacy, reduces the incidence of complications, and promotes faster recovery in patients with early-stage cervical cancer, making it a promising option for clinical practice. However, there are some limitations to this study. The small sample size warrants further analysis with a larger, multi-center cohort. Additionally, the lack of long-term follow-up means that the impact of this approach on patient prognosis remains to be fully assessed. We plan to gather more data to refine and expand our research in a future study.

Disclosure of conflict of interest

None.

Address correspondence to: Yumei Lv, Western Theater Command General Hospital, Chengdu 610083, Sichuan, China. Tel: +86-4006-9966-81; E-mail: jessicalida@126.com

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