Effect of enhanced recovery after surgery-based perioperative nursing on postoperative pain and recovery in patients with cervical cancer: A retrospective cohort study

LU MO, RUICHEN LIANG, XIANYONG WANG, ZHIWEI XIAO, ZHONGXUN WU and LIHONG CHEN

Department of Operating Room, The Affiliated Hospital, Southwest Medical University, Luzhou, Sichuan 646000, P.R. China

Received June 12, 2025; Accepted October 2, 2025

DOI: 10.3892/etm.2025.13025

Abstract. Patients with cervical cancer undergoing radical hysterectomy frequently experience substantial postoperative pain and delayed recovery. The present study aimed to evaluate the effectiveness of enhanced recovery after surgery (ERAS)-based perioperative nursing care on pain management, functional recovery and complication rates within this population of patients. A retrospective cohort study was conducted involving 327 patients who underwent type II or III radical hysterectomy for cervical cancer between January 2020 and December 2023 at a tertiary academic hospital. Patients were grouped based on the perioperative nursing model received. The ERAS group (n=162) received structured ERAS-based care, while the control group (n=165) received conventional nursing care. Primary outcomes included postoperative pain intensity assessed using the visual analog scale (VAS) at 6, 24 and 48 h. Secondary outcomes included analgesic use, patient satisfaction, recovery milestones, postoperative complications and 30-day readmission. Multivariable linear regression was conducted to identify independent predictors of pain at 24 h. Baseline characteristics were comparable between groups. VAS scores at 6, 24 and 48 h were significantly lower in the ERAS group (all P<0.001). Patients in the ERAS group also had reduced cumulative opioid use, less reliance on patient-controlled analgesia, greater adoption of non-pharmacological analgesia and higher satisfaction with pain control (all P<0.01). Functional recovery was accelerated, with earlier ambulation, oral intake, catheter removal and hospital discharge in the ERAS group (P<0.001). The overall complication rate was lower in the ERAS group compared with the control group (8.0 vs. 17.6%; P=0.009). Multivariate analysis showed that ERAS care (β=-1.05; P<0.001) and non-pharmacological analgesia (β=-0.39; P=0.010) were independently associated with lower pain scores. ERAS-based perioperative nursing significantly improved postoperative pain control, enhanced early recovery and reduced minor complications in patients with cervical cancer undergoing radical surgery. These findings support the implementation of ERAS protocols as a standard component of perioperative nursing care in gynecologic oncology.

Correspondence to: Ms. Lihong Chen, Department of Operating Room, The Affiliated Hospital, Southwest Medical University, 25 Taiping Street, Luzhou, Sichuan 646000, P.R. China
E-mail: chenlihong911004@163.com

Key words: enhanced recovery after surgery, cervical cancer, perioperative nursing, postoperative pain, recovery

Introduction

Cervical cancer remains a major global health burden, particularly in developing countries, with an estimated 604,000 new cases and 342,000 associated deaths worldwide in 2020, according to the GLOBOCAN 2020 report (1). For early-stage disease, radical hysterectomy remains a key part of curative treatment. However, patients frequently experience substantial postoperative pain, delayed gastrointestinal and physical recovery and an increased rate of minor complications, all of which negatively affect their quality of life and prolong hospitalization (2,3).

Enhanced recovery after surgery (ERAS) protocols have gained attention for improving perioperative outcomes through multimodal interventions. These include preoperative education, optimized analgesia, early feeding and mobilization strategies (4). In previous years, ERAS has been increasingly implemented in gynecologic oncology, with studies showing its efficacy in reducing the length of hospital stays, opioid use and postoperative complications (5,6). Notably, a 2023 multicenter study by Nelson *et al* (7) demonstrated that ERAS pathways in gynecologic malignancies were associated with faster bowel function recovery and improved patient satisfaction, without increasing adverse events.

However, numerous existing ERAS studies have emphasized surgical or anesthetic optimization, with limited attention given to the nursing-specific implementation and adherence of ERAS elements. Successful ERAS implementation requires high-fidelity bedside execution of core elements, structured pain assessment with multimodal and non-pharmacologic analgesia, early mobilization, nutrition and patient education, a number of which are nursing-led within perioperative workflows (8-10). In gynecologic surgery, higher adherence to these ERAS elements is associated with fewer complications, shorter hospital stays and reduced readmissions, underscoring the clinical impact of nursing-driven compliance (11).

Furthermore, the evidence supporting ERAS-based perioperative nursing in cervical cancer surgery remains sparse, especially in retrospective real-world settings.

Therefore, the present study aimed to evaluate the effectiveness of ERAS-based perioperative nursing care in reducing postoperative pain, enhancing functional recovery and lowering complication rates in patients with cervical cancer undergoing radical hysterectomy. We hypothesized that structured nursing-led ERAS protocols would lead to improved early postoperative outcomes compared with conventional nursing care.

Materials and methods

Study design. The present retrospective comparative cohort study was performed at The Affiliated Hospital of Southwest Medical University (Luzhou, China). The present study evaluated patients who underwent radical hysterectomy for cervical cancer between January 2020 and December 2023. Based on the perioperative care pathway received, patients were divided into an ERAS group and a control group. Clinical, surgical and nursing data were obtained from the hospital's electronic medical record and nursing documentation systems. The ERAS protocol was officially implemented at the institution in February 2022, allowing for natural allocation of patients by implementation period. A complete-case analysis was conducted to include all eligible patients with complete perioperative data.

Participants. Female patients who underwent elective type II or type III radical hysterectomy for cervical cancer between January 2020 and December 2023 were screened for eligibility. The inclusion criteria comprised: i) Histologically confirmed cervical cancer; ii) aged between 18-75 years; iii) American Society of Anesthesiologists (ASA) physical status classification I-III; and iv) complete medical and nursing documentation, including postoperative pain assessments (12). Exclusion criteria comprised: i) History of chronic pain or psychiatric illness; ii) preoperative opioid use; iii) emergency or palliative surgery; iv) intraoperative conversion to an alternate procedure; and v) readmission or reoperation within 7 days postoperatively. A complete-case approach was used to maximize data representativeness, resulting in a final cohort of 327 eligible patients.

Perioperative nursing intervention. Patients were categorized into two groups based on the perioperative nursing protocol received. The ERAS group was managed using a standardized institutional ERAS nursing pathway, while the control group received conventional perioperative care. The ERAS protocol included structured preoperative education and counseling, shortened fasting time (clear fluids allowed up to 2 h preoperatively), carbohydrate loading 2 h before surgery, intraoperative normothermia maintenance, fluid restriction and preventive multimodal analgesia with non-opioid agents. Postoperative nursing strategies in the ERAS group focused on early mobilization within 24 h, early oral intake, standardized pain monitoring and non-pharmacological analgesia techniques such as guided breathing, music therapy and psychological support. All ERAS nurses received formal training and protocol adherence was monitored using structured checklists, with ≥80% compliance defined as adequate implementation. By contrast, the control group received traditional nursing care, including prolonged preoperative fasting (>8 h), routine opioid-based analgesia administered as needed, delayed ambulation (>48 h postoperatively) and unstructured patient education without standardized recovery goals.

Pain and outcome assessment. The primary outcome was postoperative pain intensity, measured using the 10-point visual analog scale (VAS) at 6, 24 and 48 h after surgery (13). Pain assessments were part of routine nursing care and were recorded by ward nurses. As nurses were aware of perioperative practices (such as early mobilization in the ERAS group), complete blinding was not feasible. However, the use of a standardized VAS protocol helped to minimize subjectivity. Additional pain-related outcomes included time to first analgesia request, cumulative opioid consumption within 48 h (converted to morphine-equivalent dose), use of patient-controlled analgesia (PCA), use of non-opioid analgesics and application of non-pharmacologic pain relief methods. Patient satisfaction with pain control was assessed using a four-point Likert scale (1=very dissatisfied; 4=very satisfied) and categorized for analysis as 'satisfied' (score ≥3) or 'not satisfied' (score <3). Secondary outcomes included early functional recovery indicators comprising the time to first ambulation (defined as time from arrival in the ward to first standing or walking, assisted or unassisted), time to first flatus, time to resume oral intake, time to urinary catheter and analgesic pump removal and length of postoperative hospital stay. Recovery of independent mobility was recorded as the number of days post-surgery until walking without assistance. Postoperative complications were recorded during hospitalization and classified using the Clavien-Dindo grading system (14). Complication subtypes (fever, urinary retention or wound infection) and 30-day hospital readmissions were also recorded.

Data collection. Detailed demographic, surgical and clinical variables were extracted from institutional electronic records, including age, BMI, ASA physical status, International Federation of Gynecology and Obstetrics (FIGO) stage, surgical method (laparoscopic vs. open), surgical type (type II or III), operative time and estimated blood loss. Comorbidities such as hypertension, diabetes mellitus and cardiopulmonary disease were recorded, as were lifestyle-related factors (such as smoking or alcohol use). Laboratory parameters included preoperative hemoglobin and serum albumin levels. Postoperative nursing records were used to capture pain scores, analgesia use, recovery milestones (time to ambulation, oral intake or catheter removal), complications and discharge-related outcomes.

Statistical analysis. Data analysis was performed using SPSS version 26.0 (IBM Corp.). Normality of continuous variables was tested using the Kolmogorov-Smirnov test. Normally distributed variables were presented as mean ± SD and compared using independent-sample t-tests. Non-normally distributed variables were reported as median and interquartile range and analyzed using Mann-Whitney U tests. Categorical variables were summarized as counts and percentages and compared using χ^2 or Fisher's exact tests,

Table I. Baseline characteristics of patients with cervical cancer undergoing surgery in the ERAS and control groups.

Variable	ERAS group (n=162)	Control group (n=165)	P-value
Age, years	49.8±8.3	50.5±8.1	0.368
BMI, kg/m^2	23.4±3.2	23.1±3.4	0.422
Education level			0.289
Primary or below	18 (11.1)	22 (13.3)	
Secondary	84 (51.9)	90 (54.5)	
Tertiary or above	60 (37.0)	53 (32.1)	
ASA physical status			0.733
I	68 (42.0)	65 (39.4)	
II	81 (50.0)	86 (52.1)	
III	13 (8.0)	14 (8.5)	
FIGO stage			0.648
IA-IB	108 (66.7)	104 (63.0)	
IIA-IIB	54 (33.3)	61 (37.0)	
Surgical approach			0.518
Laparoscopic	96 (59.3)	91 (55.2)	
Open	66 (40.7)	74 (44.8)	
Surgical type III	45 (27.8)	48 (29.1)	0.782
Operative time, min	184.6±31.2	179.8±34.1	0.117
Median estimated blood loss, ml (IQR)	200 (150-300)	220 (160-320)	0.212
Preoperative VAS pain score	1.2±0.8	1.3±0.9	0.296
Hypertension	24 (14.8)	27 (16.4)	0.691
Diabetes mellitus	16 (9.9)	18 (10.9)	0.765
Cardiopulmonary disease	9 (5.6)	13 (7.9)	0.419
Smoking history	19 (11.7)	21 (12.7)	0.799
Alcohol use	17 (10.5)	23 (13.9)	0.384
Preoperative albumin, g/l	42.1±3.8	41.9±3.5	0.561
Hemoglobin, g/l	125.2±10.9	124.5±11.3	0.472

Continuous variables were compared using independent-sample t-tests or Mann-Whitney U tests. Categorical variables were compared using χ^2 tests. Continuous variables are presented as mean ± SD. Categorical variables are presented as n (%). ERAS, enhanced recovery after surgery; ASA, American Society of Anesthesiologists; FIGO, International Federation of Gynecology and Obstetrics; VAS, visual analog scale; IQR, interquartile range.

as appropriate. To identify independent predictors of pain intensity at 24 h, a multivariable linear regression model was constructed. Candidate variables included ERAS care, laparoscopic surgery, use of PCA, use of non-pharmacologic analgesia, BMI, age, ASA class, operative time, estimated blood loss and preoperative VAS pain score. Prior to model fitting, collinearity diagnostics were performed using variance inflation factor (VIF) and no variables exceeded the conventional threshold (VIF <2 for all predictors). The model's goodness of fit was evaluated using adjusted R^2 and the F-statistic. Two-tailed P<0.05 was considered to indicate a statistically significant difference.

Results

Baseline characteristics of the present study population. A total of 327 patients undergoing radical surgery for cervical cancer were included in the present analysis, with 162 assigned to the ERAS group and 165 to the control group (Table I). The two groups were well balanced with regard to baseline demographic and clinical characteristics. The mean age was 49.8±8.3 years in the ERAS group and 50.5±8.1 years in the control group (P=0.368). BMI was comparable between groups (23.4±3.2 vs. 23.1±3.4 kg/m^2, P=0.422). Distribution of education level (P=0.289), ASA physical status (P=0.733) and FIGO stage (P=0.648) showed no statistically significant differences between groups. Laparoscopic surgery was performed in 59.3% of patients in the ERAS group and 55.2% in the control group (P=0.518), and the proportion of type III radical hysterectomy was similar (27.8 vs. 29.1%; P=0.782). Operative time (P=0.117), estimated blood loss (P=0.212), preoperative VAS pain score (P=0.296), and the prevalence of comorbidities such as hypertension (P=0.691) and diabetes mellitus (P=0.765) were comparable. No significant differences were observed in smoking (P=0.799), alcohol use (P=0.384), or laboratory parameters including preoperative albumin (P=0.561) and hemoglobin (P=0.472). Overall, there were no statistically significant differences in any baseline characteristics between

Table II. Comparison of postoperative pain-related outcomes between ERAS and control groups.

A, VAS pain scores and dynamics

Variable	ERAS group (n=162)	Control group (n=165)	P-value
VAS score at 6 h	3.4±1.2; [3 (3-4)]	4.8±1.4; [5 (4-6)]	0.000001
VAS score at 24 h	2.7±1.1; [3 (2-3)]	3.9±1.3; [4 (3-5)]	0.000003
VAS score at 48 h	1.9±0.9; [2 (1-2)]	2.7±1.1; [3 (2-3)]	0.000024
VAS reduction 6-48 h	1.5±0.7; [2 (1-2)]	2.1±0.9; [2 (2-3)]	0.002

B, Analgesic use and methods

Variable	ERAS group	Control group	P-value
Cumulative opioid dose, mg	14.2±5.6; [14 (10-18)]	20.6±6.3; [20 (16-25)]	0.000001
Use of PCA devices,	51 (31.5)	97 (58.8)	0.000015
Non-opioid analgesics used	118 (72.8)	96 (58.2)	0.005
Multimodal analgesia applied	84 (51.9)	47 (28.5)	0.000038

C, Non-pharmacologic and satisfaction outcomes

Variable	ERAS group	Control group	P-value
Use of non-pharmacological pain relief	69 (42.6)	28 (17.0)	0.000004
Time to first request for analgesia, h	3.9±1.4; [4 (3-5)]	2.6±1.2; [3 (2-3)]	0.000009
Patient satisfaction with pain management	134 (82.7)	96 (58.2)	0.000003

Between-group comparisons were performed using independent-sample t-tests for normally distributed continuous variables, Mann-Whitney U tests for non-normally distributed continuous variables and χ^2 tests for categorical variables. Continuous variables are presented as mean ± SD [median (IQR)] to account for potential skewness in distribution. Categorical variables are presented as n (%). VAS, visual analog scale; PCA, patient-controlled analgesia; IQR, interquartile range; ERAS, enhanced recovery after surgery.

the two groups, indicating good comparability prior to intervention.

Postoperative pain and analgesia outcomes. Postoperative pain intensity was significantly lower in the ERAS group compared with the control group at all postoperative time points (Table II). At 6 h after surgery, the mean VAS score was 3.4±1.2 in the ERAS group and 4.8±1.4 in the control group (P<0.001). This difference remained significant at 24 h (2.7±1.1 vs. 3.9±1.3; P<0.001) and 48 h (1.9±0.9 vs. 2.7±1.1; P<0.001). Although both groups showed reductions in pain from 6 to 48 h postoperatively, the magnitude of reduction was smaller in the ERAS group (1.5±0.7 vs. 2.1±0.9; P=0.002), suggesting improved early pain control. As shown in Table II, patients in the ERAS group required significantly lower cumulative opioid doses within the first 48 h postoperatively (14.2±5.6 vs. 20.6±6.3 mg morphine equivalents; P<0.001). Additionally, the proportion of patients requiring PCA was significantly lower in the ERAS group (31.5%) compared with the control group (58.8%; P<0.001). The use of non-opioid analgesics (72.8 vs. 58.2%; P=0.005) and application of multimodal analgesia strategies (51.9 vs. 28.5%; P<0.001) were significantly more common among patients receiving

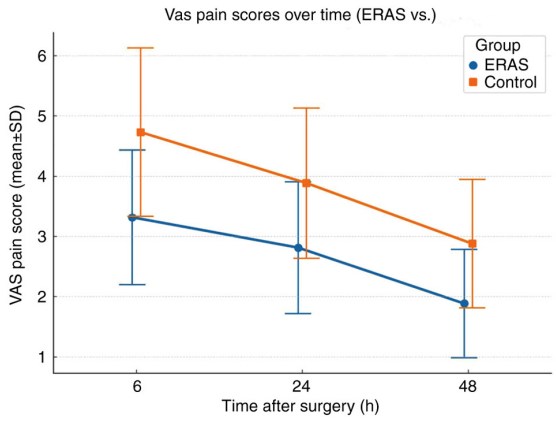

Figure 1. Trends in postoperative VAS pain scores between ERAS and control groups. Line graph showing mean VAS pain scores at 6, 24 and 48 h after surgery in the ERAS group (n=162) and control group (n=165). Values are presented as mean ± SD. VAS, visual analog scale; ERAS, enhanced recovery after surgery.

ERAS-based care. Non-pharmacologic interventions were also more frequently implemented in the ERAS group, as summarized in Table II. Methods such as guided breathing

Table III. Postoperative recovery and complications between ERAS and control groups.

A, Early recovery indicators

Variable	ERAS group (n=162)	Control group (n=165)	P-value
Time to first ambulation, h	18 (15-22)	27 (23-34)	0.000002
Time to first flatus, h	30 (26-35)	40 (34-46)	0.000004
Time to resume oral intake, h	17 (14-20)	31 (25-36)	0.000001
Time to remove urinary catheter, h	30.6±5.7	39.1±6.2	0.000003
Time to stop analgesic pump, h	41.3±6.5	53.8±8.4	0.000002

B, Overall recovery and discharge

Variable	ERAS group (n=162)	Control group (n=165)	P-value
Postoperative hospital stay, days	5 (4-6)	7 (6-9)	0.000001
Time to independent walking, days	1.8±0.7	2.5±0.9	0.000006
Discharged without assistance, n (%)	144 (88.9)	118 (71.5)	0.000013

C, Postoperative complications

Variable	ERAS group (n=162)	Control group (n=165)	P-value
Any complication, n (%)	13 (8.0)	29 (17.6)	0.009
Clavien-Dindo grade I-II, n (%)	9 (5.6)	21 (12.7)	0.031
Clavien-Dindo grade III-IV, n (%)	4 (2.5)	8 (4.8)	0.283
Fever (>38.5˚C), n (%)	6 (3.7)	14 (8.5)	0.065
Urinary retention, n (%)	4 (2.5)	9 (5.5)	0.163
Wound infection, n (%)	3 (1.9%)	6 (3.6)	0.337
30-day readmission, n (%)	4 (2.5)	8 (4.8)	0.283

Recovery times are presented as median (IQR) or mean ± SD, as appropriate. Complications were categorized according to the Clavien-Dindo classification. All P-values were calculated using the Mann-Whitney U test, independent-sample t-test or χ^2 test, as appropriate. For variables with small expected cell counts (Clavien-Dindo grade III-IV, urinary retention, wound infection and 30-day readmission), Fisher's exact test was applied. ERAS, enhanced recovery after surgery; IQR, interquartile range.

and music therapy were employed with 42.6% of patients in the ERAS group compared with only 17.0% in the control group (P<0.001). Furthermore, the time to first analgesia request was longer in the ERAS group (3.9±1.4 h) compared with in the control group (2.6±1.2 h; P<0.001), suggesting improved pain tolerance. Notably, patient satisfaction with postoperative pain management was significantly higher in the ERAS group (82.7 vs. 58.2%; P<0.001). Together these results indicated that the ERAS-based nursing pathway markedly improved pain control, reduced reliance on opioids, encouraged multimodal and non-pharmacologic pain strategies and enhanced patient satisfaction during the early postoperative period in patients with cervical cancer (Table II and Fig. 1). In the present study, the overall adherence rate to the ERAS nursing protocol was approximately 86.4%, with no notable differences in compliance across individual ERAS elements. Core components such as preoperative counseling, shortened fasting, multimodal analgesia, early mobilization, and early oral intake all demonstrated adherence rates above 80%, indicating consistent application of key protocol elements.

Postoperative recovery and complications. Patients in the ERAS group demonstrated significantly faster postoperative recovery across multiple indicators compared with those in the control group (Table III). The median time to first ambulation was 18 h in the ERAS group compared with 27 h in the control group (P<0.001), while time to first flatus and oral intake were also reduced in the ERAS group (30 vs. 40 h and 17 vs. 31 h, respectively; both P<0.001). The removal of urinary catheters and analgesic pumps occurred earlier in the ERAS group (30.6±5.7 and 41.3±6.5 h) compared with the control group (39.1±6.2 and 53.8±8.4 h; both P<0.001). Overall, functional recovery was improved in the ERAS group. The average time to independent walking was 1.8±0.7 days in the ERAS group compared with 2.5±0.9 days in the control group (P<0.001). Additionally, a higher proportion of patients in the ERAS group were discharged without assistance (88.9 vs. 71.5%; P<0.001). The median postoperative hospital stay was significantly shorter in the ERAS group [5 (4-6) days] compared with in the control group [7 (6-9) days; P<0.001]. The overall incidence of postoperative complications was

Table IV. Multivariate linear regression analysis of factors associated with VAS pain score at 24 h postoperatively (n=327).

Variable	β coefficient	95% CI	P-value
ERAS nursing care (yes vs. no)	-1.05	-1.34 to -0.76	0.000002
Preoperative VAS pain score	0.18	0.03 to 0.33	0.017
Use of PCA (yes vs. no)	0.51	0.23 to 0.80	0.000004
Use of non-pharmacological analgesia (yes vs. no)	-0.39	-0.68 to -0.09	0.010
Laparoscopic surgery (vs. open)	-0.46	-0.80 to -0.13	0.006
Age (per 1 year increase)	0.01	-0.01 to 0.03	0.264
BMI, kg/m2	0.06	0.01 to 0.11	0.031
ASA class III (vs. I-II)	0.28	-0.02 to 0.58	0.069
Operative time (per 10 min increase)	0.05	0.01 to 0.10	0.021
Estimated blood loss (per 100 ml increase)	0.09	0.01 to 0.18	0.032

Negative β coefficient indicates a reduction in VAS score associated with the variable. Multivariate linear regression analysis was used to identify independent predictors of postoperative pain score at 24 h. VAS, visual analog scale; ERAS, enhanced recovery after surgery; PCA, patient-controlled analgesia; ASA, American Society of Anesthesiologists.

lower in the ERAS group (8.0%) compared with the control group (17.6%; P=0.009). Minor complications (Clavien-Dindo grades I-II) were significantly reduced in the ERAS group (5.6 vs. 12.7%; P=0.031). There was no significant difference in the rate of major complications (Clavien-Dindo grades III-IV) between groups (P=0.283). Specific complications such as fever (P=0.065), urinary retention (P=0.163) and wound infection (P=0.337) occurred less frequently in the ERAS group, although the differences were not statistically significant. The 30-day readmission rate was also lower in the ERAS group (2.5 vs. 4.8%), but the difference did not reach statistical significance (P=0.283). These findings suggested that ERAS-based perioperative nursing markedly improved postoperative functional recovery and reduced minor complications in patients with cervical cancer undergoing surgery.

Factors associated with postoperative pain at 24 h. Multivariate linear regression analysis identified several independent predictors of VAS pain score at 24 h postoperatively (Table IV). ERAS-based nursing care was significantly associated with lower pain scores (β=-1.05; 95%CI: -1.34 to -0.76; P<0.001). The use of non-pharmacological analgesia methods also contributed to reduced pain (β=-0.39; P=0.010), while the use of PCA was associated with higher reported pain scores (β=0.51; P<0.001), perhaps reflecting more severe discomfort requiring intervention. Higher preoperative VAS scores (β=0.18; P=0.017), greater blood loss (β=0.09 per 100 ml; P=0.032) and longer operative times (β=0.05 per 10 min; P=0.021) were also positively associated with increased postoperative pain. Laparoscopic surgery was independently associated with lower pain scores compared with open surgery (β=-0.46; P=0.006). Higher BMI was significantly associated with increased pain scores (β=0.06; P=0.031), whereas age and ASA class showed no significant associations. The overall model demonstrated good fit and explanatory power (F=8.41; P<0.001; adjusted R^2=0.37), indicating that ERAS nursing and intraoperative factors together accounted for a meaningful proportion of variance in early postoperative pain. Collinearity diagnostics confirmed no evidence of multicollinearity among predictors (all VIF <2).

Discussion

The present retrospective cohort study provided evidence to support the effectiveness of ERAS-based perioperative nursing in enhancing postoperative outcomes among patients with cervical cancer undergoing radical hysterectomy. Compared with conventional care, patients managed under ERAS nursing protocols reported significantly lower pain scores, faster recovery, reduced opioid usage and fewer minor complications, all without increased rates of major adverse events or readmission.

Effective pain management is a key part of successful postoperative recovery. The present findings showed that ERAS care significantly reduced pain intensity at 6, 24 and 48 h postoperatively, aligning with previous ERAS studies in gynecologic malignancies (15-17). This improvement may be attributed to the integrated use of multimodal analgesia, reduced opioid dependence and the increased adoption of non-pharmacologic interventions, such as guided breathing and music therapy. Multivariate regression analysis confirmed ERAS nursing as an independent predictor of reduced VAS pain score at 24 h. These findings highlight the key influence of structured nursing-led protocols in optimizing early postoperative pain trajectories.

In addition to superior pain control, patients in the ERAS group achieved earlier mobilization, faster return of gastrointestinal function and shorter hospitalization, objectives that are key to ERAS (18,19). The present findings revealed that patients in the ERAS group achieved earlier ambulation (median, 18 vs. 27 h) and oral intake (17 vs. 31 h), and a higher proportion (88.9 vs. 71.5%) were discharged without assistance, reflecting superior early functional recovery. This finding aligns with recent prospective studies indicating that early ambulation after abdominal or pelvic cancer surgery is associated with a reduced risk of postoperative venous thromboembolism and paralytic ileus (20,21). These benefits are plausibly mediated by ERAS nursing components that promote early mobilization and multimodal, opioid-sparing analgesia, which together reduce opioid-related gastrointestinal hypomotility and

facilitate earlier activity and feeding (18-21). Preoperative counseling and goal-setting may enhance patient participation and adherence, supporting earlier independent ambulation and discharge.

Notably, ERAS care was associated with a lower incidence of Clavien-Dindo grade I-II complications. While the reduction in major complications and readmission was not statistically significant, the observed trends suggest a positive clinical trajectory (22-24). Consistent implementation of nursing-led elements, such as optimized fluid management, active temperature maintenance and structured postoperative monitoring, has been linked to fewer minor infections and urinary complications in ERAS pathways, which is concordant with the present study findings (8,11,22).

A key strength of the present study lies in its nursing-centered focus. Numerous ERAS studies emphasize surgical techniques or anesthetic interventions yet overlook the operational role of nursing staff (25,26). The present findings reinforced that the quality and consistency of nursing practice were central to ERAS success. Trained nurses were responsible not only for implementing daily care interventions, but also for promoting patient education, protocol adherence and recovery assessment, all factors shown to influence ERAS outcomes across specialties (27).

However, several limitations warrant consideration. First, the retrospective design inherently carries risks of information and selection bias, even with statistical adjustments. Second, the present study was conducted at a single academic institution, which may limit generalizability, particularly in settings lacking dedicated ERAS training programs. Third, postoperative pain scores were documented by ward nurses as part of routine clinical care. As the nurses were aware of perioperative practices (including earlier ambulation and oral intake in the ERAS group), true blinding was not feasible. This limitation raised the possibility of detection bias, although the standardized use of the VAS scale aimed to minimize subjectivity. Fourth, as allocation was purely time-based (2020-2021 for conventional care and February 2022 onwards for ERAS) potential temporal confounding factors, such as gradual refinements in surgical practice, evolving hospital protocols and the impact of the COVID-19 pandemic cannot be completely excluded. This may have introduced a degree of detection bias, although standardized use of the VAS scale was applied to mitigate subjectivity. With this, patient-level factors such as anxiety, depression and cultural attitudes toward pain, which are known to influence postoperative outcomes, were not captured in this analysis. Fifth, nursing compliance rates or ERAS fidelity scores were not quantified, both of which are key metrics in ERAS implementation science. Lastly, long-term functional outcomes, patient-reported quality of life and cost-effectiveness were not evaluated in the present study but remain important targets for future prospective research.

In conclusion, the present study demonstrated that ERAS-based perioperative nursing was associated with improved pain management, faster recovery and lower minor complication rates in cervical cancer surgery. These findings support the integration of standardized nursing protocols within ERAS frameworks and underscore the need for scalable, nurse-led ERAS models in gynecologic oncology.

Acknowledgements

Not applicable.

Funding

No funding was received.

Availability of data and materials

The data generated in the present study may be requested from the corresponding author.

Authors' contributions

LM contributed to the study design, data collection and manuscript drafting. RL participated in data curation, statistical analysis and interpretation of results. XW assisted with patient screening, clinical data extraction and literature review. ZX was responsible for coordinating clinical procedures and quality control of perioperative data. ZW contributed to the implementation of the ERAS nursing protocol and provided key revisions to the manuscript. LC contributed to the conception and design of the study, critically reviewed all data analyses for methodological accuracy, guided the interpretation of findings and revised the manuscript for important intellectual content. LM and RL confirm the authenticity of all the raw data. All authors have read and approved the final version of the manuscript.

Ethics approval and consent to participate

The present study was conducted in accordance with the Declaration of Helsinki and was approved by the Ethics Committee of The Affiliated Hospital of Southwest Medical University (approval no. KY2025317). Due to the retrospective nature of the present study and the use of anonymized patient data, the requirement for informed consent was waived by the committee.

Patient consent for publication

Not applicable.

Competing interests

The authors declare that they have no competing interests.

References

1. Sung H, Ferlay J, Siegel RL, Laversanne M, Soerjomataram I, Jemal A and Bray F: Global cancer statistics 2020: GLOBOCAN estimates of incidence and mortality worldwide for 36 cancers in 185 countries. CA Cancer J Clin 71: 209-249, 2021.
2. Li DL, Li W and Chen ZJ: Enhanced recovery after surgery in the perioperative period promotes recovery of cervical cancer patients undergoing transabdominal radical resection. Am J Transl Res 17: 230-238, 2025.
3. Benlolo S, Hanlon JG, Shirreff L, Lefebvre G, Husslein H and Shore EM: Predictors of persistent postsurgical pain after hysterectomy-A prospective cohort study. J Minim Invasive Gynecol 28: 2036-2046.e1, 2021.
4. Ljungqvist O, Scott M and Fearon KC: Enhanced recovery after surgery: A review. JAMA Surg 152: 292-298, 2017.

5. Bhandoria GP, Bhandarkar P, Ahuja V, Maheshwari A, Sekhon RK, Gultekin M, Ayhan A, Demirkiran F, Kahramanoglu I, Wan YL, *et al*: Enhanced recovery after surgery (ERAS) in gynecologic oncology: An international survey of peri-operative practice. Int J Gynecol Cancer 30: 1471-1478, 2020.
6. Bisch SP, Jago CA, Kalogera E, Ganshorn H, Meyer LA, Ramirez PT, Dowdy SC and Nelson G: Outcomes of enhanced recovery after surgery (ERAS) in gynecologic oncology-A systematic review and meta-analysis. Gynecol Oncol 161: 46-55, 2021.
7. Nelson G, Fotopoulou C, Taylor J, Glaser G, Bakkum-Gamez J, Meyer LA, Stone R, Mena G, Elias KM, Altman AD, *et al*: Enhanced recovery after surgery (ERAS®) society guidelines for gynecologic oncology: Addressing implementation challenges-2023 update. Gynecol Oncol 173: 58-67, 2023.
8. Balfour A, Amery J, Burch J and Smid-Nanninga H: Enhanced recovery after surgery (ERAS): Barriers and solutions for nurses. Asia Pac J Oncol Nurs 9: 100040, 2022.
9. Brown D and Xhaja A: Nursing perspectives on enhanced recovery after surgery. Surg Clin North Am 98: 1211-1221, 2018.
10. Akbuğa GA and Yılmaz K: Obstacles to compliance and implementation of ERAS protocol from nursing perspective: A qualitative study. J Perianesth Nurs 40: 331-336, 2025.
11. Hayek J, Zorrilla-Vaca A, Meyer LA, Mena G, Lasala J, Iniesta MD, Suki T, Huepenbecker S, Cain K, Garcia-Lopez J and Ramirez PT: Patient outcomes and adherence to an enhanced recovery pathway for open gynecologic surgery: A 6-year single-center experience. Int J Gynecol Cancer 32: 1443-1449, 2022.
12. Mayhew D, Mendonca V and Murthy BVS: A review of ASA physical status-historical perspectives and modern developments. Anaesthesia 74: 373-379, 2019.
13. Myles PS, Myles DB, Galagher W, Boyd D, Chew C, MacDonald N and Dennis A: Measuring acute postoperative pain using the visual analog scale: The minimal clinically important difference and patient acceptable symptom state. Br J Anaesth 118: 424-429, 2017.
14. Clavien PA, Barkun J, de Oliveira ML, Vauthey JN, Dindo D, Schulick RD, de Santibañes E, Pekolj J, Slankamenac K, Bassi C, *et al*: The Clavien-Dindo classification of surgical complications: Five-year experience. Ann Surg 250: 187-196, 2009.
15. Chao L, Lin E and Kho K: Enhanced recovery after surgery in minimally invasive gynecologic surgery. Obstet Gynecol Clin North Am 49: 381-395, 2022.
16. Asklid D, Ljungqvist O, Xu Y and Gustafsson UO: Short-term outcome in robotic vs. laparoscopic and open rectal tumor surgery within an ERAS protocol: A retrospective cohort study from the Swedish ERAS database. Surg Endosc 36: 2006-2017, 2022.
17. Bogani G, Sarpietro G, Ferrandina G, Gallotta V, DI Donato V, Ditto A, Pinelli C, Casarin J, Ghezzi F, Scambia G and Raspagliesi F: Enhanced recovery after surgery (ERAS) in gynecology oncology. Eur J Surg Oncol 47: 952-959, 2021.
18. Nelson G: Enhanced recovery in gynecologic oncology surgery-state of the science. Curr Oncol Rep 25: 1097-1104, 2023.
19. Ding Y, Zhang X, Qiu J, Zhang J and Hua K: Assessment of ESGO quality indicators in cervical cancer surgery: A real-world study in a high-volume chinese hospital. Front Oncol 12: 802433, 2022.
20. Porserud A, Aly M, Nygren-Bonnier M and Hagströmer M: Association between early mobilisation after abdominal cancer surgery and postoperative complications. Eur J Surg Oncol 49: 106943, 2023.
21. Egger EK, Merker F, Ralser DJ, Marinova M, Vilz TO, Matthaei H, Hilbert T and Mustea A: Postoperative paralytic ileus following debulking surgery in ovarian cancer patients. Front Surg 9: 976497, 2022.
22. Tazreean R, Nelson G and Twomey R: Early mobilization in enhanced recovery after surgery pathways: Current evidence and recent advancements. J Comp Eff Res 11: 121-129, 2022.
23. Shen Y, Lv F, Min S, Wu G, Jin J, Gong Y, Yu J, Qin P and Zhang Y: Impact of enhanced recovery after surgery protocol compliance on patients' outcome in benign hysterectomy and establishment of a predictive nomogram model. BMC Anesthesiol 21: 289, 2021.
24. Chen Y, Wan J, Zhu Z, Su C and Mei Z: Embedding evidence of early postoperative off-bed activities and rehabilitation in a real clinical setting in China: An interrupted time-series study. BMC Nurs 21: 98, 2022.
25. Wainwright TW, Jakobsen DH and Kehlet H: The current and future role of nurses within enhanced recovery after surgery pathways. Br J Nurs 31: 656-659, 2022.
26. Peña CG: What makes a nurse a good ERAS nurse? Asia Pac J Oncol Nurs 9: 100034, 2022.
27. Francis NK, Walker T, Carter F, Hübner M, Balfour A, Jakobsen DH, Burch J, Wasylak T, Demartines N, Lobo DN, *et al*: Consensus on training and implementation of enhanced recovery after surgery: A delphi study. World J Surg 42: 1919-1928, 2018.